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ABSTRACT

The Rate Training Manual and Nonresident Career Course (RTM/NRCC) form a self-study package that enables Aviation Boatswain's Mate F to fulfill the requirements for advancement to ABF1 and the ABF1 for advancement to the rank of ABFC. In preparing for advancement examinations, the manual should be studied in conjunction with Military Requirements for Petty Officers 1 and C, NavPers 10057 (series). Chapter one discusses the enlisted rating structure, the requirements for advancement, responsibilities involved in advancement, and various advancement opportunities. Chapters two through ten cover the following topics: aviation fuels division afloat, JP-5 systems afloat, operation of the JP-5 system, gasoline systems afloat, aviation lube oil system, fuels division ashore, quality assurance and surveillance, maintenance and repair, and administration. The document concludes with a subject index and a 61-page course assignment booklet. (BP)

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AVIATION
BOATSWAIN'S MATE F 1 & C

NAVAL EDUCATION AND TRAINING COMMAND

RATE TRAINING MANUAL
AND NONRESIDENT CAREER COURSE

NAVEDTRA 10304-C

CE 004654

NAVAL EDUCATION AND TRAINING PROGRAM DEVELOPMENT CENTER
PENSACOLA, FLORIDA 32559

May 1975

Specific Instruction and Errata for
Rate Training Manual and Nonresident Career Course
AVIATION BOATSWAIN'S MATE F 1&C, NAVEDTRA 10304-C

No attempt has been made to issue corrections for errors in typing, punctuation, etc., which are obvious to the enrollee and do not affect the student's ability to answer the item.

Textbook, NAVEDTRA 10304-C
Make the following change:

Preface, page i — Delete the last sentence of the third paragraph: "The NRCC is designated... successfully." Reason: This statement is in error as it conflicts with the "points" statement in the Naval Reserve Retirement box in the NRCC.

JUL 25 1975

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PREFACE

The ultimate purpose of training Naval personnel is to produce a combatant Navy which can ensure victory at sea. A consequence of the quality of training given them is their superior state of readiness. Its result is a victorious Navy.

This Rate Training Manual and Nonresident Career Course (RTM/NRCC) form a self-study package that will enable ambitious Aviation Boatswain's Mate F to help themselves fulfill the requirements of their rating.

Designed for individual study and not formal classroom instruction, the RTM provides subject matter that relates directly to the occupational qualifications of the Aviation Boatswain's Mate F rating. The NRCC provides the usual way of satisfying the requirements for completing the RTM. The set of assignments in the NRCC includes learning objectives and supporting items designed to lead students through the RTM. The NRCC is designated a major revision, and retirement point credit will be granted to Naval Reservists who complete (or retake) it successfully.

This training Manual and nonresident career course was prepared by the Naval Education and Training Program Development Center, Pensacola, Florida, for the Chief of Naval Education and Training. Technical assistance was provided by the Aviation Boatswain's Mate School, Lakehurst, New Jersey and the Naval Sea Systems Command.

1975 Edition

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WASHINGTON, D.C.: 1975

THE UNITED STATES NAVY

GUARDIAN OF OUR COUNTRY

The United States Navy is responsible for maintaining control of the sea and is a ready force on watch at home and overseas, capable of strong action to preserve the peace or of instant offensive action to win in war.

It is upon the maintenance of this control that our country's glorious future depends; the United States Navy exists to make it so.

WE SERVE WITH HONOR

Tradition, valor, and victory are the Navy's heritage from the past. To these may be added dedication, discipline, and vigilance as the watchwords of the present and the future.

At home or on distant stations we serve with pride, confident in the respect of our country, our shipmates, and our families.

Our responsibilities sober us; our adversities strengthen us.

Service to God and Country is our special privilege. We serve with honor.

THE FUTURE OF THE NAVY

The Navy will always employ new weapons, new tecnniques, and greater power to protect and defend the United States on the sea, under the sea, and in the air.

Now and in the future, control of the sea gives the United States her greatest advantage for the maintenance of peace and for victory in war.

Mobility, surprise, dispersal, and offensive power are the keynotes of the new Navy. The roots of the Navy lie in a strong belief in the future, in continued dedication to our tasks, and in reflection on our heritage from the past.

Never have our opportunities and our responsibilities been greater.

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CHAPTER 1

AVIATION BOATSWAIN'S MATE F RATING

This training manual is designed to aid the ABF2 in preparing for advancement to ABF1 and the ABF1 in preparing for advancement to ABFC. It is based primarily on the professional requirements or qualifications for ABF1 and ABFC, as specified in the Manual of Qualifications for Advancement, NavPers 18068 (Series). In preparing for advancement examinations, this manual should be studied in conjunction with Military Requirements for Petty Officers 1 & C, NavPers 10057 (Series). The latter covers the military requirements for all first class and chief petty officers.

ENLISTED RATING STRUCTURE

The present enlisted rating structure includes two types of ratings–general ratings and service ratings.

GENERAL RATINGS are designed to provide paths of advancement and career development. A general rating identifies a broad occupational field of related duties and functions requiring similar aptitudes and qualifications. General ratings provide the primary means used to identify billet requirements and personnel qualifications. Some general ratings include service ratings; others do not. Both Regular Navy and Naval Reserve personnel may hold general ratings.

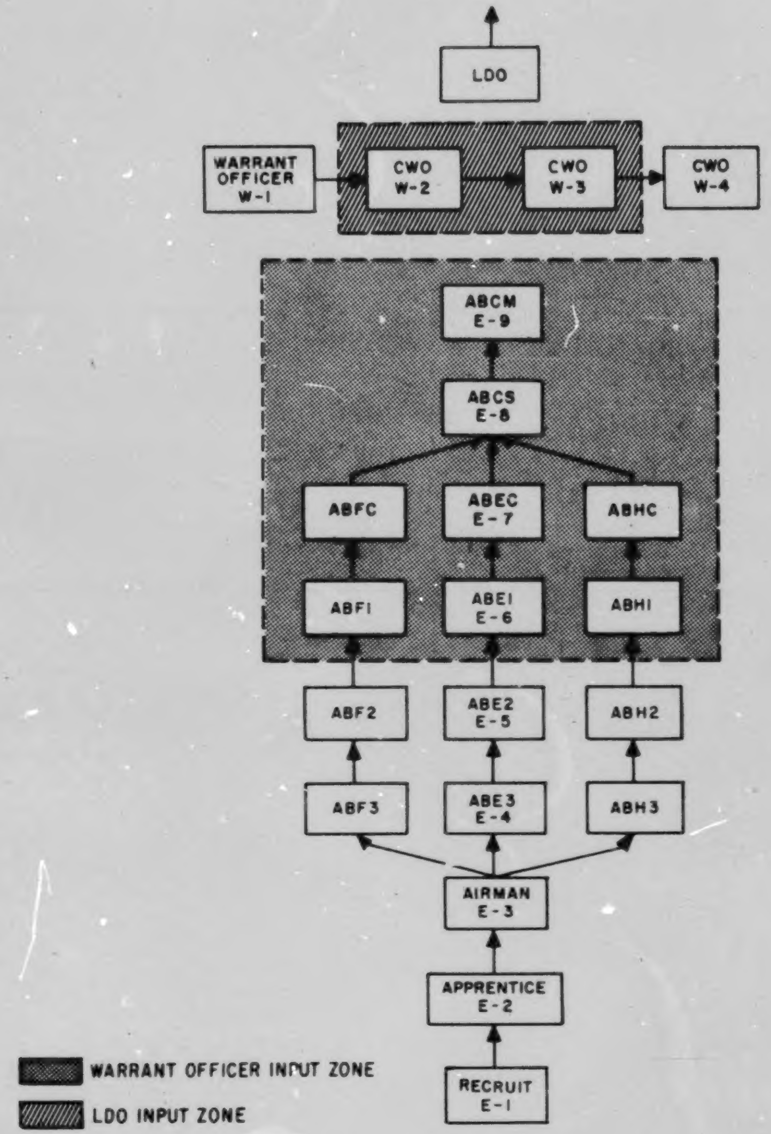
Subdivisions of certain general ratings are identified as SERVICE RATINGS. These service ratings identify areas of specialization within the scope of a general rating. Service ratings are established in those general ratings in which specialization is essential for efficient utilization of personnel. Although service ratings can exist at any petty officer level, they are most common at the PO3 and PO2 levels. Both Regular Navy and Naval Reserve personnel may hold service ratings.

ABF RATING

The ABF rating is a service rating and is included in Navy Occupational Group IX (Aviation). The general rating, AB, applies at the E-8 and E-9 levels.

Figure 1-1 illustrates all paths of advancement for an Airman Recruit to Master Chief Aviation Boatswain's Mate, Warrant Officer (W-4), and Limited Duty Officer. Shaded areas indicate career stages where qualified enlisted personnel may advance to Warrant Officer (W-1), and selected Warrant Officers may advance to Limited Duty Officer. Personnel in enlisted rates and ratings and warrant ranks not in a shaded area may advance only as indicated by the arrows.

The Manual of Qualifications for Advancement, NavPers 18068 (Series), states that ABF's operate, maintain, and repair aviation fueling and lubricating oil systems on aircraft carriers, including aviation fuel and lubricating oil service stations and pumprooms, piping, valves, pumps, tanks, and portable equipment related to the fuel system; operate, maintain, and repair the valves and piping systems within the Air Department spaces aboard carriers; supervise the operation and servicing of fuel pits, fuel farms, and equipment associated with the fueling and defueling of aircraft ashore and afloat; operate and service motorized fueling equipment; maintain fuel quality assurance and surveillance in aviation fuel systems ashore and afloat; train, direct, and supervise firefighting crews, fire rescue teams,


LDO
WARRANT OFFICER W-1
CWO W-2
CWO W-3
CWO W-4
ABCM E-9
ABCS E-8
ABFC
ABEC E-7
ABHC
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AIRMAN E-3
APPRENTICE E-2
RECRUIT E-1
WARRANT OFFICER INPUT ZONE
LDO INPUT ZONE

195.1

Figure 1-1.—Paths of advancement.

and damage control parties in assigned fuel and lubricating oil spaces; and observe and enforce fuel-handling safety precautions.

The aviation fuels chief supervises the personnel assigned to the aviation fuels division. ABF1's are normally assigned to supervise flight deck and hangar deck fueling crews, the operation and maintenance of equipment assigned to the aviation fuels division, and operational procedures. They also enforce safety precautions and assist the chief in the administration of the division.

On shore stations, senior ABF's may be assigned to supervise the operation of the mobile refuelers.

A wide variety of assignments ashore is available to the ABF1 and ABFC. In addition to the routine billets to which lower rated ABF's are assigned, the ABF1 and ABFC are eligible for assignment to instructor duty as well as a number of other desirable billets. Most of these billets are directly associated with training. Some of the more desirable billets to which the ABF1 and ABFC may be assigned are described in the following paragraphs.

1. Instructor duty is available to both the ABF1 and ABFC in the ABF Schools at NATTC, Lakehurst, N. J. Another possibility for instructor duty is at NATTC, Memphis, Millington, Tenn.

Instructor billets are normally filled on a voluntary basis. Detailed information concerning assignment to instructor duty is contained in the Enlisted Transfer Manual, NavPers 15909 (Series).

2. ABFC's are also eligible for assignment to duty with the Naval Education and Training Program Development Center headquartered at Pensacola, Florida, as a Technical Writer to assist in the preparation of Rate Training Manuals and Nonresident Career Courses (formerly called Enlisted Correspondence Courses) for the AB ratings, and as an item writer in the preparation of Navy-wide advancement examinations for enlisted personnel.

For a listing of other special programs and projects, reference should be made to the Enlisted Transfer Manual. Others are also announced from time to time in BuPers Notices.

Personnel may indicate their desire for assignment to a specific program or project by indicating it in the "remarks" block of their Rotation Data Card.

In today's modern Navy there is an awesome array of weapons and ships. Who can say which one is the most important? It is a known fact that our modern carrier force, whether it be our CVA's, CVS's, or CV's is one of the big deterrents to any world power thinking of armed conflict. The striking power and the maneuverability of our carriers are what make them so important in the defense of the free world.

This is why you as a senior petty officer in the ABF rating should realize the importance of your position. You, as ABF's, play a very important part in keeping your ship a fighting ship.

As a result of the Naval Leadership Program a considerable amount of material related to naval leadership for the senior petty officer is available. Studying this material will make you aware of your many leadership responsibilities as a senior petty officer; and will also be of great help in developing leadership qualities. It will not in itself, however, make you a good leader. Leadership principles can be taught, but a good leader acquires that quality only through hard work and practice.

As you study this material containing leadership traits, keep in mind that probably none of our most successful leaders possessed all of these traits to a maximum degree, but a weakness in some traits was more than compensated for by strength in others. Critical self-evaluation will enable you to realize the traits in which you are strong, and to capitalize on them. At the same time you must constantly strive to improve on the traits in which you are weak.

Your success as a leader will be decided, for the most part, by your achievements in inspiring others to learn and perform. This is best accomplished by personal example.

ADVANCEMENT

By this time, you are probably well aware of the personal advantages of advancement–higher pay, greater prestige, more interesting and challenging work, and the satisfaction of getting ahead in your chosen career. By this time, also, you have probably discovered that one of the most enduring rewards of advancement is the training you acquire in the process of preparing for advancement.

The Navy also profits by your advancement. Highly trained personnel are essential to the functioning of the Navy. By advancement, you increase your value to the Navy in two ways:

First, you become more valuable as a person who can supervise, lead, and train others and second, you become more valuable as a technical specialist and thus make far-reaching contributions to the entire Navy.

Since you are studying for advancement to PO1 or CPO, you are probably already familiar with the requirements and procedures for advancement. However, you may find it helpful to read the following sections. The Navy does not stand still. Things change all the time, and it is possible that some of the requirements have changed since the last time you went up for advancement. Furthermore, you will be responsible for training others for advancement; therefore, you will need to know the requirements in some detail.

HOW TO QUALIFY FOR ADVANCEMENT

To qualify for advancement, a person must:

1. Have a certain amount of time in grade.
2. Complete the required military and professional training manuals.
3. Demonstrate the ability to perform all the PRACTICAL requirements for advancement by completing applicable portions of the Record of Practical Factors, NavEdTra 1414/1 (formerly NavPers 760).
4. Be recommended by his commanding officer.
5. Demonstrate his KNOWLEDGE by passing a written examination on (a) military requirements, and (b) professional qualifications.

Remember that the requirements for advancement can change. Check with your educational services office to be sure that you know the most recent requirements.

When you are training lower rated personnel, it is a good idea to point out that advancement is not automatic. Meeting all the requirements makes a person ELIGIBLE for advancement. Such factors as the score made on the written examination, length of time in service, performance marks, and quotas enter into the final determination of who will actually be advanced.

HOW TO PREPARE FOR ADVANCEMENT

Preparation for advancement includes studying the qualifications, working on the practical factors, studying the required Rate Training Manuals, and studying any other material that may be specified. To prepare yourself for advancement or to help others prepare for advancement, you will need to be familiar with (1) the "Quals" Manual, (2) the Record of Practical Factors, NavEdTra 1414/1, (3) a NavEdTra publication called Bibliography for Advancement Study, NavEdTra 10052 (Series) and (4) Rate Training Manuals. The following sections describe these materials and give some information on how to use them to the best advantage.

"Quals" Manual

The Manual of Qualifications for Advancement, NavPers 18068 (Series), gives the minimum requirements for advancement to each rate within each rating. This manual is usually called the "Quals" Manual, and the qualifications are of two general types: (1) military requirements, and (2) professional or technical qualifications. Military requirements apply to all ratings rather than to any one rating alone. Professional qualifications are technical or professional requirements that are directly related to the work of each rating.

Both the military requirements and the professional qualifications are divided into subject matter groups. Then, within each subject matter group, they are divided into PRACTICAL FACTORS and KNOWLEDGE FACTORS.

The qualifications for advancement and a bibliography of study materials are available in your educational services office. The "Quals" Manual is changed more frequently than Rate

Training Manuals are revised. By the time you are studying this training manual, the "quals" may have been changed. Never trust any set of "quals" until you have checked the change number against an UP-TO-DATE copy of the "Quals" Manual.

In training others for advancement, emphasize these three points about the "quals":

1. The "quals" are the MINIMUM requirements for advancement. Personnel who study MORE than the required minimum will have a great advantage when they take the written examinations for advancement.

2. Each "qual" has a designated rate level—chief, first class, second class, or third class. You are responsible for meeting all "quals" specified for the rate level to which you are seeking advancement AND all "quals" specified for lower rate levels.

3. The written examinations for advancement will contain questions relating to the practical factors AND to the knowledge factors of BOTH the military requirements and the professional qualifications.

Record of Practical Factors

A special form known as the Record of Practical Factors, NavEdTra 1414/1 for the appropriate rating, is used to record the satisfactory performance of the practical factors. This form lists all military and all professional practical factors. Whenever a person demonstrates his ability to perform a practical factor, appropriate entries must be made in the DATE and INITIAL columns. As a PO1 or CPO, you will often be required to check the practical factor performance of lower rated personnel and to report the results to your supervising officer.

As changes are made periodically to the "Quals" Manual, new NavEdTra 1414/1 forms are provided when necessary. Extra space is allowed on the Record of Practical Factors for entering additional practical factors as they are published in changes to the "Quals" Manual. The Record of Practical Factors also provides space for recording demonstrated proficiency in skills which are within the general scope of the rate but which are not identified as minimum qualifications for advancement. Keep this in mind when you are training and supervising other personnel. If a person demonstrates proficiency in some skill which is not listed in the "quals" but which is within the general scope of the rate, report this fact to the supervising officer so that an appropriate entry can be made in that person's Record of Practical Factors.

When you are transferred, the Record of Practical Factors should be forwarded with your service record to your next duty station. It is a good idea to check and be sure that this form is actually inserted in your service record before you are transferred. If the form is not in your record, you may be required to start all over again and requalify in practical factors that have already been checked off. You should also take some responsibility for helping lower rated personnel keep track of their practical factor records when they are transferred.

A second copy of the Record of Practical Factors should be made available to each man in pay grades E-3 through E-8 for his personal record and guidance.

NavEdTra 10052

Bibliography for Advancement Study, NavEdTra 10052 (Series) is a very important publication for anyone preparing for advancement. This publication lists required and recommended Rate Training Manuals and other reference material to be used by personnel working for advancement. NavEdTra 10052 (Series) is revised and issued once each year by the Naval Education and Training Support Command. Each revised edition is identified by a letter following the NavEdTra number. When using this publication, be SURE you have the most recent edition.

The required and recommended references are listed by rate level in NavEdTra 10052 (Series). It is important to remember that you are responsible for all references at lower rate levels, as well as those listed for the rate to which you are seeking advancement.

Rate Training Manuals that are marked with an asterisk (*) in NavEdTra 10052 are MANDATORY at the indicated rate levels. The completion requirements of a mandatory training manual may be satisfied by (1) passing the appropriate Nonresident Career Course that is based on the mandatory training manual, (2) passing locally prepared tests based on the information given in the mandatory training manual, or (3) in some cases, successfully completing an appropriate Navy school.

When training personnel for advancement, do not overlook the section of NavEdTra 10052 which lists the required and recommended references relating to the military requirements for advancement. All personnel must complete the mandatory military requirements training manual for the appropriate rate level before they can be eligible to advance. Also, make sure that personnel working for advancement study the references which are listed as recommended but not mandatory in NavEdTra 10052. It is important to remember that ALL references listed in NavEdTra 10052 may be used as source material for the written examinations, at the appropriate levels.

Rate Training Manuals

There are two general types of Rate Training Manuals. Manuals (such as this one) are prepared for most enlisted rates and ratings, giving information that is directly related to the professional qualifications for advancement. Basic manuals give information that applies to more than one rate and rating.

Rate Training Manuals are revised from time to time to bring them up to date. The publication, List of Training Manuals and Correspondence Courses, NavEdTra 10061 (Series), which is revised annually, contains a listing of current Rate Training Manuals and their identifying numbers. The letter following the number identifies the latest revision; for example, -A indicates first revision, -B indicates second revision, etc.

Rate Training Manuals are designed for the special purpose of helping naval personnel prepare for advancement. By this time, you have probably developed your own way of studying these manuals. Some of the personnel you train, however, may need guidance in the use of Rate Training Manuals. Although there is no single "best" way to study a training manual, the following suggestions have proved useful for many people:

1. Study the military requirements and the professional qualifications for your rate before you study the training manual, and refer to the "quals" frequently as you study. Remember, you are studying the training manual primarily to meet these "quals."

2. Before you begin to study any part of the training manual intensively, get acquainted with the entire manual. Read the preface and the table of contents. Check through the index. Thumb through the manual without any particular plan, looking at the illustrations and reading bits here and there as you see things that interest you.

3. Look at the training manual in more detail, to see how it is organized. Look at the table of contents again. Then, chapter by chapter, read the introduction, the headings, and the subheadings. This will give you a pretty clear picture of the scope and content of the manual.

4. When you have a general idea of what is in the training manual and how it is organized, fill in the details by intensive study. In each study period, try to cover a complete unit—it may be a chapter, a section of a chapter, or a subsection. The amount of material you can cover at one time will vary. If you know the subject well, or if the material is easy, you can cover quite a lot at one time. Difficult or unfamiliar material will require more study time.

5. In studying each unit, write down questions as they occur to you. Many people find it helpful to make a written outline of the unit as they study, or at least to write down the most important ideas.

6. As you study, relate the information in the training manual to the knowledge you already have. When you read about a process, a skill, or a situation, ask yourself some questions. Does this information tie in with past experience? Is this something new and different? How does this information relate to the qualifications for advancement?

7. When you have finished studying a unit, take time out to see what you have learned. Look back over your notes and questions. Without looking at the training manual, write down the main ideas you have learned from studying this unit. Do not just quote the manual. If you cannot give these ideas in your

own words, the chances are that you have not really mastered the information.

8. Use Nonresident Career Courses whenever you can. These courses are based on Rate Training Manuals or other appropriate texts. As mentioned before, completion requirements of a mandatory Rate Training Manual can be satisfied by passing the Nonresident Career Course based on the training manual. You will probably find it helpful to take other courses, as well as those based on mandatory training manuals. Taking additional courses helps you to master the information given in the training manuals, and also gives you an idea of how much you have learned.

INCREASED RESPONSIBILITIES

When you assumed the duties of a PO3, you began to accept a certain amount of responsibility for the work of others. With each advancement, you accept an increasing responsibility in military matters and in matters relating to the professional work of your rate. When you advance to PO1 or CPO, you will find a noticeable increase in your responsibilities for leadership, supervision, training, working with others, and keeping up with new developments.

As your responsibilities increase, your ability to communicate clearly and effectively must also increase. The simplest and most direct means of communication is a common language. The basic requirement for effective communication is therefore a knowledge of your own language. Use correct language in speaking and in writing. Remember that the basic purpose of all communication is understanding. To lead, supervise, and train others, you must be able to speak and write in such a way that others can understand exactly what you mean.

Leadership and Supervision

As a PO1 or CPO, you will be regarded as a leader and supervisor. Both officers and enlisted personnel will expect you to translate the general orders given by officers into detailed, practical, on-the-job language that can be understood and followed by relatively inexperienced personnel. In dealing with your juniors, it is up to you to see that they perform their jobs correctly. At the same time, you must be able to explain to officers any important problems or needs of enlisted personnel. In all military and professional matters, your responsibilities will extend both upward and downward.

Along with your increased responsibilities, you will also have increased authority. Officers and petty officers have POSITIONAL authority–that is, their authority over others lies in their positions. If your CO is relieved, for example, he no longer has the degree of authority over you that he had while he was your CO, although he still retains the military authority that all seniors have over subordinates. As a PO1, you will have some degree of positional authority; as a CPO, you will have even more. When exercising your authority, remember that it is positional–it is the rate you have, rather than the person you are, that gives you this authority.

A Petty Officer conscientiously and proudly exercises his authority to carry out the responsibilities he is given. He takes a personal interest in the success of both sides of the chain of command . . . authority and responsibility. The Petty Officer who does not seek out and accept responsibility, loses his authority and then the responsibility he thinks he deserves. He must be sure, by his example and by his instruction, that the Petty Officers under him also accept responsibility. In short, he must be the leader his title–Petty Officer–says he is.

Training

As a PO1 or CPO, you will have regular and continuing responsibilities for training others. Even if you are lucky enough to have a group of subordinates who are all highly skilled and well trained, you will still find that training is necessary. For example, you will always be responsible for training lower rated personnel for advancement. Also, some of your best workers may be transferred, and inexperienced or poorly trained personnel may be assigned to you. A particular job may call for skills that none of your personnel have. These and similar problems require that you be a training specialist–one who can conduct formal and informal training programs to qualify personnel for advancement, and one who can train individuals and groups in the effective execution of assigned tasks.

In using this training manual, study the information from two points of view. First, what do you yourself need to learn from it? And second, how would you go about teaching this information to others?

Training goes on all the time. Every time a person does a particular piece of work, some learning is taking place. As a supervisor and as a training expert, one of your biggest jobs is to see that your personnel learn the RIGHT things about each job so that they will not form bad work habits. An error that is repeated a few times is well on its way to becoming a bad habit. You will have to learn the difference between oversupervising and not supervising enough. No one can do his best work with a supervisor constantly supervising. On the other hand, you cannot turn an entire job over to an inexperienced person and expect that person to do it correctly without any help or supervision.

In training lower rated personnel, emphasize the importance of learning and using correct terminology. A command of the technical language of your occupational field enables you to receive and convey information accurately and to exchange ideas with others. A person who does not understand the precise meaning of terms used in connection with his work is definitely at a disadvantage when he tries to read official publications relating to his work. He is also at a great disadvantage when he takes examinations for advancement. To train others in the correct use of technical terms, you will need to be very careful in your own use of words. Use correct terminology and insist that personnel you are supervising use it too.

You will find the Record of Practical Factors, NavEdTra 1414/1, a useful guide in planning and carrying out training programs. From this record, you can tell which practical factors have been checked off for each person and which ones have not yet been done. Use this information to plan a training program that will fit the needs of the personnel you are training.

On-the-job training is usually controlled through daily and weekly work assignments. When you are working on a tight schedule, you will generally want to assign each person to the part of the job that you know he can do best. In the long run, however, you will gain more by assigning personnel to a variety of jobs so that each person can acquire broad experience. By giving people a chance to do carefully supervised work in areas in which they are relatively inexperienced, you will increase the range of skills of each person and thus improve the flexibility of your working group.

Working with Others

As you advance to PO1 or CPO, you will find that many of your plans and decisions affect a large number of people, some of whom are not even in your own occupational field. It becomes increasingly important, therefore, for you to understand the duties and the responsibilities of personnel in other ratings. Every petty officer in the Navy is a technical specialist in his own field. Learn as much as you can about the work of others, and plan your own work so that it will fit into the overall mission of the organization.

Keeping Up With New Developments

Practically everything in the Navy—policies, procedures, publications, equipment systems—is subject to change and development. As a PO1 or CPO, you must keep yourself informed about changes and new developments that affect you or your work in any way.

Some changes will be called directly to your attention, but others will be harder to find. Try to develop a special kind of alertness for new information. When you hear about anything new in the Navy, find out whether there is any way in which it might affect your work. If so, find out more about it.

SOURCES OF INFORMATION

As a PO1 or CPO, you must have an extensive knowledge of the references to consult for accurate, authoritative, up-to-date information on all subjects related to the military and professional requirements for advancement.

Publications mentioned in this chapter are subject to change or revision from time to time—some at regular intervals, others as the need arises. When using any publication that is subject to revision, make sure that you have the latest edition. When using any publication that is kept current by means of changes, be sure you have a copy in which all official changes have been made.

A list of training manuals and publications that will be helpful as references and for additional study in preparing for advancement is included in the reading list at the beginning of the text. Additional training manuals that are applicable are available through your educational services officer.

In addition to training manuals and publications, training films furnish a valuable source of supplementary information. Films that may be helpful are listed in the U. S. Navy Film Catalog, NavAir 10-1-777.

ADVANCEMENT OPPORTUNITIES FOR PETTY OFFICERS

Making chief is not the end of the line as far as advancement is concerned. Advancement to Senior (E-8) and Master (E-9) Chief, Warrant Officer, and Commissioned Officer are among the opportunities that are available to qualified petty officers. These special paths of advancement are open to personnel who have demonstrated outstanding professional ability, the highest order of leadership and military responsibility, and unquestionable moral integrity.

PROFICIENCY PAY

The determination as to which Navy ratings, NEC's, and Special Duty Assignments are authorized proficiency pay is accomplished through an annual review, within the Bureau of Naval Personnel. Those ratings, NEC's, or special duty assignments which fulfill the Department of Defense criteria for an award of proficiency pay are included in a proposed fiscal year Proficiency Pay Program submitted to the Secretary of Defense for approval.

The Secretary of Defense has authorized two categories of Proficiency Pay for Navy personnel:

1. Shortage Specialty (Proficiency Pay). A monthly amount of pay in addition to any pay and allowances to which otherwise entitled that may be awarded to an eligible enlisted member who possesses a critical rating or NEC. Shortage Specialty pay is designed to assist in attaining and sustaining adequate career manning levels in critical ratings and NEC's.

2. Special Duty Assignment (Proficiency Pay). A monthly amount of pay in addition to any pay and allowances to which otherwise entitled that may be awarded to an eligible enlisted member who is assigned to certain special duties. Special Duty Assignment pay is designed to assist in attaining and sustaining an adequate volunteer manning level in the critical special duty assignments.

ADVANCEMENT TO SENIOR AND MASTER CHIEF

Chief petty officers may qualify for the advanced grades of Senior and Master Chief. These advanced grades provide for substantial increases in pay, together with increased responsibilities and additional prestige. The requirements for advancement to Senior and Master Chief are subject to change but, in general, include a certain length of time in grade, a certain length of time in the naval service, a recommendation by the commanding officer, and a sufficiently high mark on the Navy-wide examination. The final selection for Senior and Master Chief is made by a regularly convened selection board.

Examination Subjects

Qualifications for advancement to Senior Chief Petty Officer and Master Chief Petty Officer have been developed and published in the Manual of Qualifications for Advancement, NavPers 18068 (Series). They officially establish minimum military and professional qualifications for Senior and Master Chief Petty Officers.

The Bibliography for Advancement Study, NavEdTra 10052 (Series), contains a list of study references which may be used to study for both military and professional requirements.

Satisfactory completion of the Nonresident Career Course titled Military Requirements for Senior and Master Chief Petty Officer, NavEdTra 91209, is mandatory for advancement to E-8 and E-9.

When preparing for advancement to Senior (ABCS) or Master (ABCM) Chief, it is suggested that you study the additional material listed in Study Guide for Aviation Boatswain's Mate E-8 and E-9, NavPers 10114.

ADVANCEMENT TO WARRANT AND COMMISSIONED OFFICER

The Warrant Officer program provides opportunity for advancement to warrant rank for E-6 and above enlisted personnel. E-6's, to be eligible, must have passed an E-7 rating exam prior to selection.

The LDO program provides a path of advancement from warrant officer to commissioned officer. LDO's are limited, as are warrants, in their duty, to the broad technical fields associated with their former rating.

If interested in becoming a warrant or commissioned officer, ask your educational services officer for the latest requirements that apply to your particular case.

CHAPTER 2

AVIATION FUELS DIVISION AFLOAT

This chapter covers the organization, duties, and responsibilities of the aviation fuels division aboard aircraft carriers, amphibious assault (LPH), and amphibious transport dock (LPD) type ships.

TYPICAL V-4 DIVISION ORGANIZATION

It must be emphaszied that you will encounter many variations of AvFuels Divisons afloat. This has been brought about by the different types of ships employed by the Navy that must have the capability of fueling and defueling aircraft. Regardless of the type of ship, keep in mind that the basic mission of the division remains the same; therefore, the basic division structure does not change. Some of the variations you will be confronted with when organizing a division will be the number of men assigned to the division, the number and types of aircraft embarked, and the tactical employment of your ship. The number of jobs and responsibilities of an AvFuels Division on an LPD remains the same as on a CVA. The difference is the number of personnel available to perform the division's mission. (See fig. 2-1.)

AVIATION FUELS OFFICER

The basic function of the AvFuels Officer is to direct and supervise the fueling and defueling of aircraft in accordance with instructions from the aircraft handling officer. Other equally important duties and responsibilities are to:

1. Supervise and maintain records of the expenditures of all aviation fuels and lubricating oil and keep the aircraft handling officer informed as to the amount of aviation fuels required for replenishment.
2. Supervise aviation fuel replenishment, ensuring the proper connection of the fueling hose and bonding wire and the proper operation of the fueling system. Also inform the officer-of-the-deck and the supply officer on the quantity of fuel received at the completion of the operation.
3. Maintain an active quality assurance program to ensure quality of the delivered aviation fuels and lubricants.
4. Ensure compliance with all safety regulations in the handling of aviation fuels and lubricating oil.
5. Supervise training of the V-4 division personnel.
6. Act as division officer in the administration of the V-4 division.
7. Supervise the maintenance and repair of the AvFuels systems.
8. Obtain the services of other than AvFuels division personnel if assistance is required to repair certain equipment.
9. Direct the AvFuels division in handling malfunctions of the AvFuels and lube oil systems.
10. Submit required reports.
11. Initiate requisitions for general supplies, repair parts, and equipment.
12. Determine and report to the Aviation Supply Officer the quantity and quality of aviation fuels and aviation lube oil.

LEADING CHIEF PETTY OFFICER

The leading CPO is the senior CPO of the division, and all other CPO's of the division are

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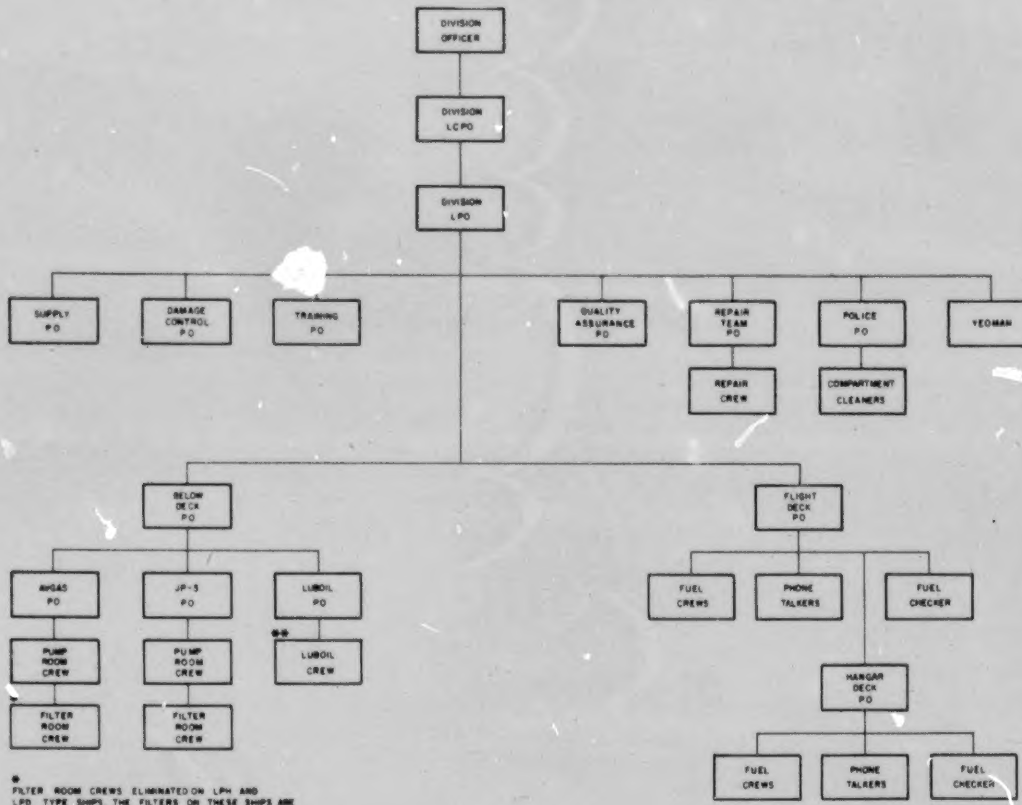

DIVISION OFFICER
DIVISION LCPO
DIVISION LPO
SUPPLY PO
DAMAGE CONTROL PO
TRAINING PO
QUALITY ASSURANCE PO
REPAIR TEAM PO
POLICE PO
YEOMAN
REPAIR CREW
COMPARTMENT CLEANERS
BELOW DECK PO
FLIGHT DECK PO
AVGAS PO
JP-5 PO
LUBOIL PO
PUMP ROOM CREW
PUMP ROOM CREW
**
LUBOIL CREW
*
FILTER ROOM CREW
FILTER ROOM CREW
FUEL CREWS
PHONE TALKERS
FUEL CHECKER
HANGAR DECK PO
FUEL CREWS
PHONE TALKERS
FUEL CHECKER

*
FILTER ROOM CREWS ELIMINATED ON LPH AND LPD TYPE SHIPS THE FILTERS ON THESE SHIPS ARE LOCATED AT FUELING STATIONS OR IN PUMPROOMS

**
LUBOIL CREW WILL OPERATE AND MAINTAIN CLEANING SOLVENT SYSTEMS ON SHIPS SO EQUIPPED

ON SHIPS HAVING SMALL DIVISIONS SOME OF THE ABOVE JOBS MUST BE COMBINED

198.1

Figure 2-1.—Typical AvFuels Division Organization.

subordinate to him. He has authority over all enlisted personnel of the V-4 division and ensures that the material upkeep and maintenance of the aviation fuels systems are properly performed. He is also responsible for ensuring that the cleanliness of the spaces assigned to the division conform with the high standards established for the ship. His specific duties are to:

1. Pursue a vigorous training program in accordance with departmental and divisional policies.
2. Maintain logs and submit reports as required.
3. Control the personal appearance of all personnel of the division.
4. Muster the division daily and make a report of this muster to the division officer.
5. Maintain an up-to-date watch, quarter, and station bill for the division.
6. Supervise the upkeep, repair, and cleaning of all assigned spaces and machinery.
7. Recommend to the division officer the assignment of men to billet numbers.

8. Screen special requests, indicate recommended or not recommended, and forward for approval or disapproval in the prescribed form.

9. Assist the division officer in the preparation of Reports of Enlisted Performance Evaluation (NavPers 1616/18W for E-6 and below and NavPers 1616/8W for E-7 and above).

10. Advise the division officer when there is a need for an extension of the normal working day to maintain material upkeep and cleanliness of spaces to conform to division standards.

11. Disable vital machinery only after permission has been obtained from the division officer.

12. Perform such other duties as directed by proper authority. An assistant leading CPO may be assigned to the V-4 division, depending upon the total number of ABFC's assigned to the air department. The assistant leading CPO aids the leading CPO in all of the above duties and acts as the leading CPO in his absence.

LEADING PETTY OFFICER

The aviation fuels leading petty officer is primarily responsible for the administrative functioning of the division. During operations involving the handling of aviation fuels, he acts as a roving supervisor to coordinate the activities of the entire division. The leading petty officer is the senior petty officer (other than CPO's) assigned to the division. All other petty officers are subordinate to him.

The specific duties and responsibilities of the leading petty officer correspond closely with those of the leading CPO. These duties may be considered to be performed on a more personal basis, in that the leading petty officer deals directly with the junior petty officers and men in the division, and serves as liaison between them and the leading CPO.

Some of the more important responsibilities of the leading petty officer are the maintenance of the training program; enforcement of safety regulations; and the upkeep of the division watch, quarter, and station bill. The leading petty officer also prepares the division daily watch list and ensures that all personnel standing the aviation fuels security watch are properly qualified.

AVIATION FUELS BELOW DECKS PETTY OFFICER

The below decks petty officer supervises all operations of related equipment located below the main deck. Specific duties and responsibilities are as follows:

1. Supervise pumproom petty officers in operations of JP-5, aviation gasoline, lube oil, contaminated lube oil, and auxiliary systems.
2. Supervise pumproom petty officers in operation of filter rooms.
3. Supervise pumproom petty officers in stripping of JP-5 tanks.
4. Act as aviation fuels control supervisor during the receipt, transfer, and discharge of all aviation fuels.
5. Supervise all repairs and tests to aviation fuels equipment and spaces below the main deck.
6. Supervise usage sequence so that JP-5 is used in accordance with tank cleaning schedule.
7. Ensure that damage control settings are properly maintained at all times.
8. Ensure strict adherence to all safety precautions.
9. Supervise the cleaning of all assigned spaces.
10. Supervise and monitor sound powered phone circuit.
11. Perform such other duties as may be assigned.

AVIATION FUELS FLIGHT AND HANGAR DECK PETTY OFFICER

The aviation fuels flight and hangar deck petty officers supervise the operation and maintenance of the aviation fueling stations on their respective decks. His specific duties and responsibilities are to:

1. Maintain a log on the fueling stations and supervise the taking of fuel samples at fueling stations as required by applicable instructions.
2. Ensure that all applicable safety precautions are observed.
3. Supervise the upkeep, repair, and cleaning of all fueling stations and other spaces assigned.

4. Ensure that all men assigned are thoroughly instructed in their duties.
5. Obtain permission from the division officer prior to performing any fueling or defueling operations.
6. Ask the officer-of-the-deck to have the "smoking lamp" put out prior to performing any operation involving the handling of aviation fuel or making repairs.
7. Ensure that all men assigned are in proper uniform.
8. Muster the fueling crews and any other personnel assigned flight quarters stations in connection with the fueling and defueling of aircraft on the flight or hangar deck.

AVGAS AND JP-5 PETTY OFFICERS

The AvGas and JP-5 petty officers are responsible for the operation and maintenance of all below decks machinery and equipment of their respective systems. Specific duties performed in their respective systems are to:

1. Maintain all logs and reports and supervise the taking of fuel samples as required.
2. Ensure that all safety precautions and orders are strictly complied with, including the checking of safety shields on flange joints in machinery spaces.
3. Supervise the upkeep, repair, and cleaning of all machinery and spaces assigned.
4. Supervise and instruct all assigned personnel in the proper operation and repair of machinery and equipment.
5. Obtain permission from the division officer before undertaking any major repairs.
6. Ensure proper ventilation in fuel pumprooms and filter rooms.
7. Ensure that only authorized personnel are permitted in aviation fuel spaces.
8. Ensure that all damage control settings are correct at all times.
9. Perform such other duties as may be assigned.

AVIATION FUELS REPAIR TEAM PETTY OFFICER

The repair team petty officer supervises the maintenance of the aviation fuels systems on the main deck and above. Specific duties and responsibilities include the following:

1. Maintain a master maintenance log of the aviation fuels systems.
2. Ensure the proper handling and stowage of tools and spare parts and aviation fuel testing and emergency equipment under the custody of the V-4 division.
3. Supervise the upkeep and cleanliness of repair team shop and stowage spaces.
4. Ensure that all men assigned are thoroughly instructed in their duties.
5. Ensure that all safety, testing, and emergency equipment is in proper working condition.
6. Ensure that all safety precautions are observed.
7. Conduct maintenance and repair of all aviation fueling equipment above the main deck.
8. Supervise the stowage and issue of division cleaning gear.
9. Assume the duties of the division damage control petty officer during his absence.
10. Conduct periodic checks on spare sound-powered telephone sets.
11. Perform such other duties as may be assigned.

LUBE OIL PETTY OFFICER

The lube oil petty officer supervises all operations and maintenance of the aviation lube oil system. His specific duties and responsibilities are to:

1. Supervise the operation of the aviation lube oil system and the distribution of lube oil.

2. Supervise replenishment of the aviation lube oil system.

3. Train assigned personnel in safe work habits and in the proper operation of the lube oil system.

4. Supervise the maintenance, repair, and cleaning of all assigned machinery and spaces.
5. Obtain permission from the division officer prior to making any major repairs.

6. Perform such other duties as may be assigned.

OTHER ADMINISTRATIVE PERSONNEL

Other key billets of an aviation fuels division include the education and training petty officer, the safety petty officer, the damage control petty officer, quality assurance petty officer, and the police petty officer. These billets are generally filled by ABF2's and ABF3's and may be assigned as a collateral duty. When assigning personnel to these billets, the senior ABF should choose the most qualified personnel available and ensure that they are properly trained and checked out in their assigned duties. This assures a smooth running division and relieves the senior petty officers of many small details in order that their attention may be directed to the more important duties.

AVIATION FUELS SECURITY WATCH

One of the most important functions of the AvFuels division is the proper standing of the aviation fuels security watch. This watch is stood 24 hours a day when the ship is not at flight quarters. Only qualified personnel from the AvFuels division will stand this watch and every effort should be put forth by the division police petty officer to ensure that the watch-standers understand the importance of their watch. The AvFuels security watch is responsible for the security of the AvFuels system. To ensure that the system is secure, he must:

1. Make hourly inspections of all designated spaces and piping.
2. Immediately notify the AvFuels Officer, Air Department Integrity Watch Officer, and OOD if discrepancies are noted.
3. Make hourly reports to the OOD (Air Department Integrity Watch Officer if squadrons are embarked).
4. Insert entries in appropriate logbooks on each inspection tour.
5. Safeguard against any welding or burning near the AvFuels system unless the system has been properly freed of fuel and vapors.
6. Ensure compliance with all safety precautions.
7. Perform such other duties as may be assigned.

NOTE: If manning levels permit, the security watch should be a two-man watch to ensure the safety of personnel involved.

CHAPTER 3

JP-5 SYSTEMS AFLOAT

The majority of JP-5 fueling systems installed aboard carriers today were converted from the original high capacity aviation gasoline system. This is true for the CVA's constructed prior to the USS KITTY HAWK (CVA-63), all CVS's, and even some of the older LPH's. Even the newer systems on our most modern carriers were designed along the same lines as these conversions.

In order to give the broadest possible coverage of all the different types of systems (as to size, scope, and capacities) with a minimum of repetition, it will first be necessary to briefly review the history of the aviation fuel systems.

The CV-33 type system (commonly referred to as the low capacity system), capable of dispensing aviation gasoline at a maximum rate of only 1,000 gpm (500 gpm forward and 500 gpm aft), was adequate for World War II type aircraft. (See fig. 3-1.) However, as aircraft increased in size and speed, thereby requiring a larger quantity of fuel, it became necessary to increase the stowage capacity of the aviation fuel system and the rate at which aircraft could be refueled.

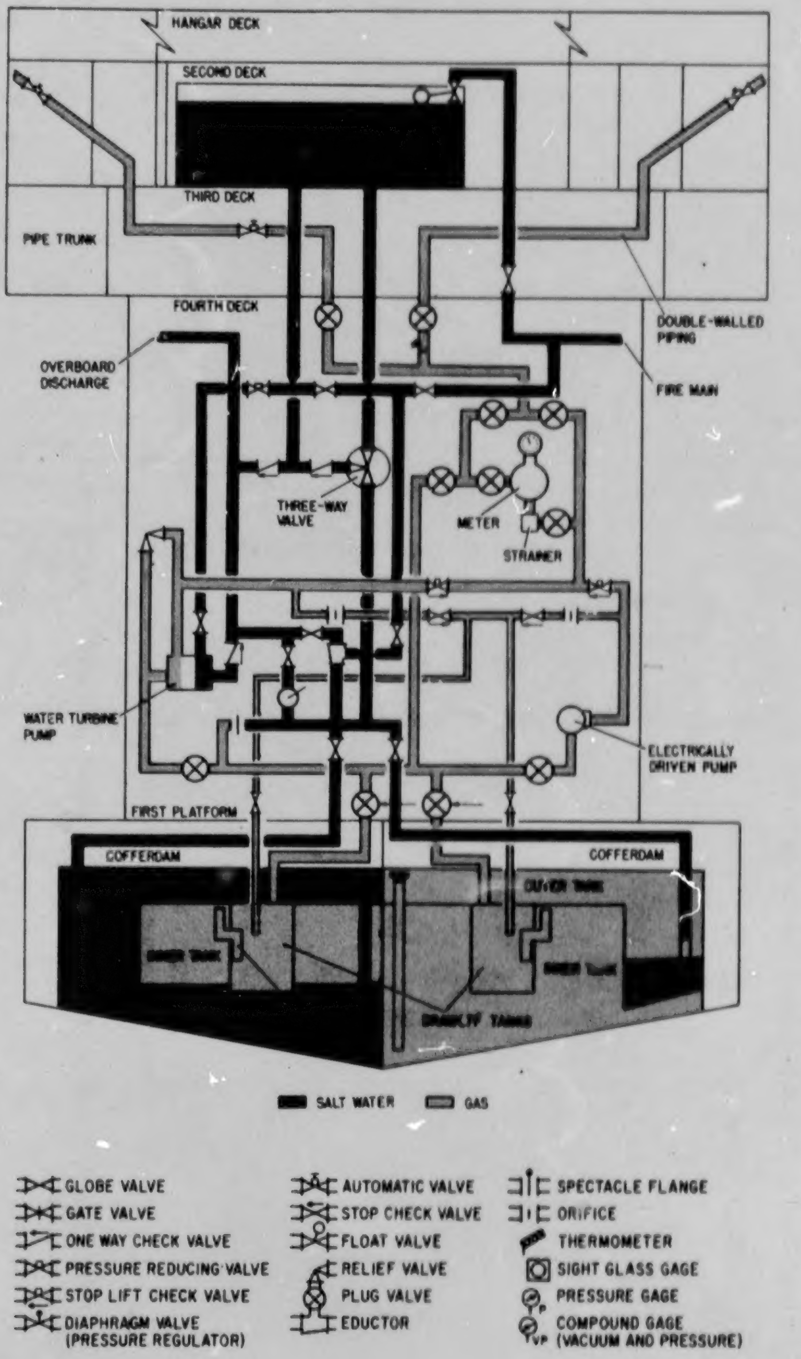
The original high capacity aviation gasoline system was designed for this increased capacity. (See fig. 3-2.) The stowage tanks for this system were basically the same as the low capacity system tanks, though larger, and arranged in the same manner. They were located below the first platform deck–two sets forward and two sets aft (one set on either side of the centerline).

Sea water for this system was provided by four 600 gpm sea water pumps in each pumproom. The pumps were fed directly from a sea chest located in the bottom of the ship. The discharge from these pumps was directed to the outer tank sea water supply risers and the overboard discharge. An elevated loop in the overboard discharge established the required head of pressure to force the gasoline out of the tanks to the AvGas pumps. The loop also limits the amount of pressure that could be applied to the tank structure. This makes it independent of the ship's fire main system and eliminates the use of the sea water gravity tank. Additional lines are provided for flushing, draining, and steaming the tanks.

The gasoline side of the system was also enlarged. Four 675 gpm aviation gasoline booster pumps were installed in each pumproom–two pumps for each distribution riser. The distribution risers (that section of piping from the pumproom to the flight and hangar decks) were increased to 6 inches in diameter. Each distribution riser contained an automatic pressure-regulating system, a forward and reverse flowmeter, and a high-capacity filter, plus several aircraft service stations designed to fuel and defuel aircraft simultaneously.

The distribution risers were divided into four quadrants: quadrant 1 forward, starboard; quadrant 2 forward, port; quadrant 3 aft, starboard; and quadrant 4 aft, port. All four quadrants were cross-connected to enable any aircraft service station to be supplied from any stowage tank. This system had a maximum delivery rate of aviation gasoline (115/145) of 1,200 gpm per quadrant.

The aviation fueling systems originally installed on the first four super carriers (CVA 59, 60, 61 and 62) were identical to the one previously described except for their stowage and distribution capabilities. These carriers employed six sets of saddle-type stowage tanks, four sets forward and two sets aft. The aviation gasoline booster pumps had a rated capacity of


HANGAR DECK
SECOND DECK
THIRD DECK
PIPE TRUNK
FOURTH DECK
DOUBLE-WALLED PIPING
OVERBOARD DISCHARGE
FIRE MAIN
THREE-WAY VALVE
METER
STRAINER
WATER TURBINE PUMP
ELECTRICALLY DRIVEN PUMP
FIRST PLATFORM
COFFERDAM
COFFERDAM
OUTER TANK
INNER TANK
INNER TANK
DRAINOFF TANKS
SALT WATER
GAS
GLOBE VALVE
GATE VALVE
ONE WAY CHECK VALVE
PRESSURE REDUCING VALVE
STOP LIFT CHECK VALVE
DIAPHRAGM VALVE (PRESSURE REGULATOR)
AUTOMATIC VALVE
STOP CHECK VALVE
FLOAT VALVE
RELIEF VALVE
PLUG VALVE
EDUCTOR
SPECTACLE FLANGE
ORIFICE
THERMOMETER
SIGHT GLASS GAGE
PRESSURE GAGE
COMPOUND GAGE (VACUUM AND PRESSURE)
P
VP

198.2

Figure 3-1.—Low capacity aviation gasoline system.

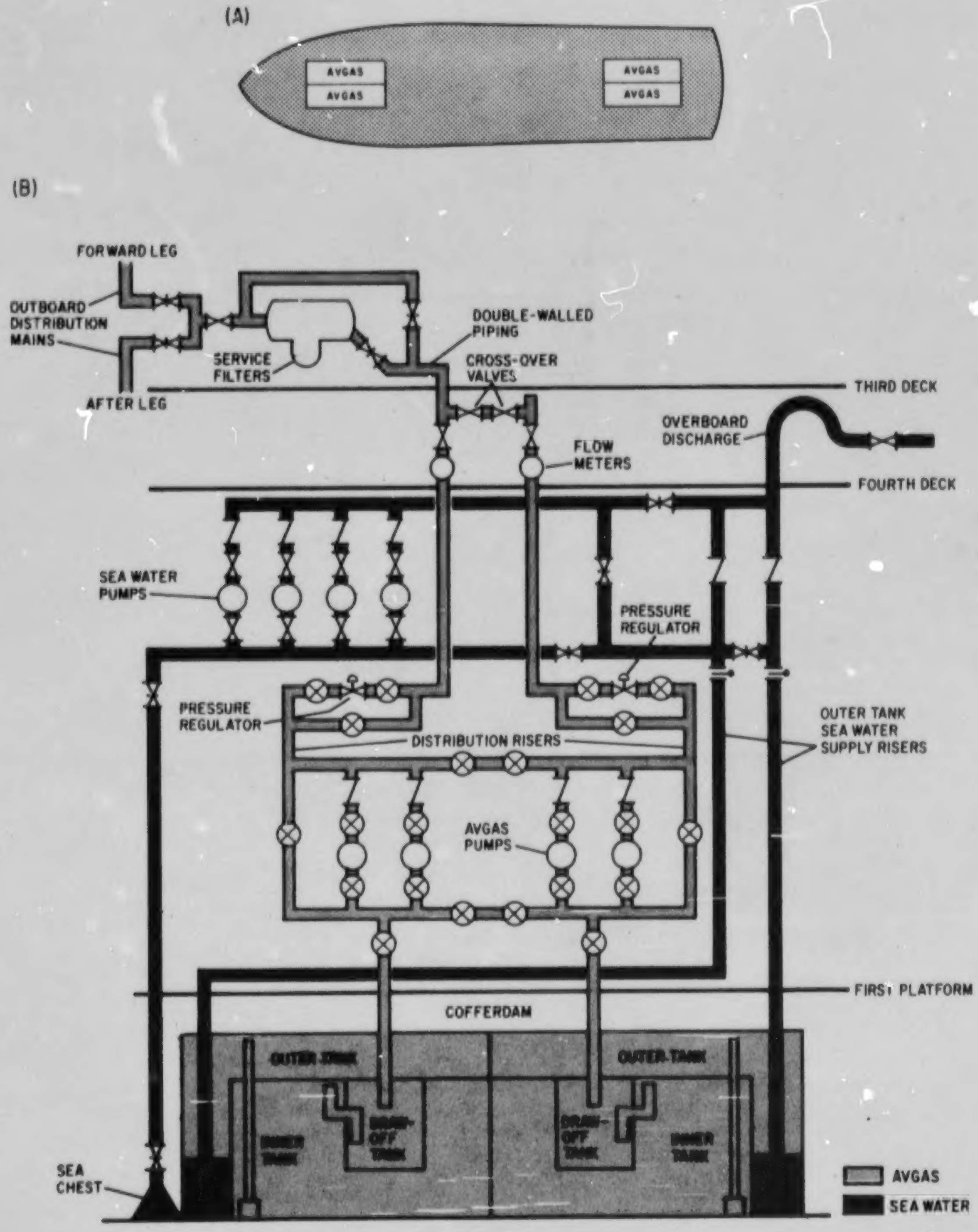

(A)
AVGAS
AVGAS
AVGAS
AVGAS
(B)
FORWARD LEG
OUTBOARD DISTRIBUTION MAINS
AFTER LEG
SERVICE FILTERS
DOUBLE-WALLED PIPING
CROSS-OVER VALVES
THIRD DECK
OVERBOARD DISCHARGE
FLOW METERS
FOURTH DECK
SEA WATER PUMPS
PRESSURE REGULATOR
PRESSURE REGULATOR
DISTRIBUTION RISERS
OUTER TANK SEA WATER SUPPLY RISERS
AVGAS PUMPS
FIRST PLATFORM
COFFERDAM
OUTER TANK
OUTER TANK
DRAW-OFF TANK
DRAW-OFF TANK
INNER TANK
INNER TANK
SEA CHEST
AVGAS
SEA WATER

Figure 3-2.—High capacity aviation gasoline system.

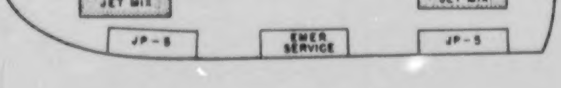
198.3

1,100 gpm and the sea water pumps 1,000 gpm. The distribution risers were also enlarged to 8 inches in diameter. These systems had a maximum delivery rate of aviation gasoline (115/145) of 2,000 gpm per quadrant.

The first major change to the aviation high capacity gasoline system was the introduction of jet mix. (See fig. 3-3.)

When jet aircraft first became operational in the fleet, they burned 115/145 aviation gasoline. The "original" high capacity system was capable of effectively refueling this new high-speed aircraft but the stowage capacity for AvGas was found to be insufficient for jet aircraft operating on an around-the-clock schedule during the Korean War. Since an increase in the protected fuel storage space was not practical, a fuel which could be stored in unprotected tanks was developed. This fuel was JP-5, a special, high flashpoint (140 degrees F) kerosene. As an interim measure until all jet engines could be tested and approved for operation on JP-5 fuel, a system was devised for blending one part of AvGas with two parts of JP-5 to make a fuel called "Jetmix" which had volatility characteristics similar to the JP-3 and JP-4 fuels used at shore stations.

A number of ship's black oil tanks were converted to JP-5 stowage tanks. These tanks were arranged in two groups, one group forward and one group aft. Each group had an equal number of port and starboard tanks. Although the normal stowage capacity of ship's black oil fuel was decreased somewhat, the ship's range was not affected, as JP-5 could, in an emergency, be used as boiler fuel. Consequently, some means had to be provided to deliver JP-5 to the engineers in the event of this emergency. Eight amidship wing tanks (4 port and 4 starboard, 2 per boilerroom), which are normally empty voids, were designated as EMERGENCY SERVICE TANKS for this purpose. A transfer main running fore and aft interconnected the forward and after group of JP-5 stowage tanks and the emergency service tanks. A number of filling connections installed on the port and starboard side of the hangar deck were interconnected with the transfer main by downcomers.



198.4
Figure 3-3.—Jet mix aviation gasoline (tank arrangement).

Four JP-5 transfer pumps were installed on the seventh deck level, two forward and two aft. These pumps were of the 1,000 gpm at 100 psi centrifugal type. (See Worthington JP-5 pump, fig. 3-4.) A blender was installed in each aviation gasoline pumproom (first platform). The suction header of the transfer pumps was connected to the fore and aft transfer main. The discharge header was connected to one side of the blender. The piping in the aviation gasoline pumproom was modified to enable the starboard AvGas pumps to discharge into the other side of the blender.

JP-5 was received aboard through the hangar deck filling connections and directed via the transfer main to the forward and after group of stowage tanks. An equal number of port and starboard tanks were filled as a unit. After the JP-5 was allowed to settle for a prescribed length of time, it was stripped of all water and solids. The existing black oil stripping system was utilized for this purpose.

The transfer pumps then took suction from an equal number of port and starboard stowage tanks and discharged into one side of the blender. Only one pump in each pumproom was used for this operation. The other was designated as a standby. Simultaneously, one of the starboard AvGas pumps was used to transfer aviation gasoline from the starboard set of AvGas tanks to the other side of the blender. The end result, JET MIX, was then stowed in the port AvGas tanks both forward and aft. As the JP-5 stowage tanks were emptied, they could be ballasted with sea water if necessary.

The port AvGas pumps and the port quadrants 2 and 4 were used to dispense jet mix to jet aircraft on the port side only. All cross-connecting piping between the port and starboard quadrants were blanked off. With the addition of the wing stowage tanks, the jet mix

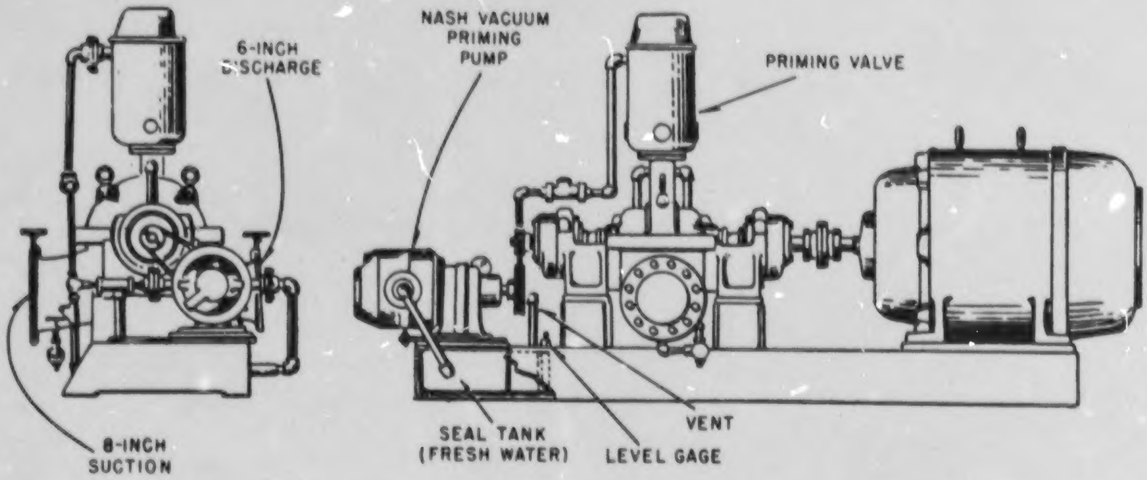


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Figure 3-4.—Worthington JP-5 transfer pump.

system resulted in a substantial increase in the overall aircraft fuel capacity of the carrier.

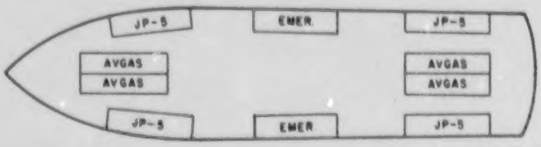

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Figure 3-5.—Interim JP-5 system (tank arrangement).

The conversion of all jet engines to operate efficiently on JP-5 alone caused the jet mix system to become obsolete. However, the conversion from the jet mix system to the interim aviation fuel system was comparatively simple. (See fig. 3-5.) Four of the existing wing stowage tanks, two forward (1 port and 1 starboard) and two aft (1 port and 1 starboard), were converted to and designated as JP-5 service tanks. A separate filling and a separate suction line and a hand-operated stripping pump were installed in these tanks. The sea water ballast connections were removed.

NOTE: JP-5 service tanks are never ballasted with sea water.

Stripping JP-5 stowage tanks with the black oil stripping system proved time-consuming and wasteful and an independent JP-5 stripping system was installed. This system had four stripping pumps—two forward and two aft. These pumps served to strip the JP-5 stowage and service tanks of water and solids. The blenders were removed from the aviation gasoline pumprooms. The existing JP-5 pump discharge header was connected directly to the port distribution risers in the aviation gasoline pumproom. The port saddle tanks were returned for storage of aviation gasoline. The two aviation gasoline pumps that were used for delivery of jet mix were returned as standby aviation gasoline pumps in the starboard quadrant. One of the JP-5 pumps in each pumproom was designated as a transfer pump and the other as a service pump. A first-stage filter (fig. 3-6) was installed between the transfer pumps and the service tanks. The piping to the inlet side of the filter was orificed to limit the flow to 200 gpm.

JP-5 was received aboard in the same manner as in the jet mix system. After it had been allowed to settle for a prescribed period of time, it was stripped of all water and solids and transferred via the transfer filter to the service tanks. After the JP-5 in the service tanks had settled for a second prescribed period of time, it was again stripped of any water or solids

198.7

Figure 3-6.—Transfer filters.

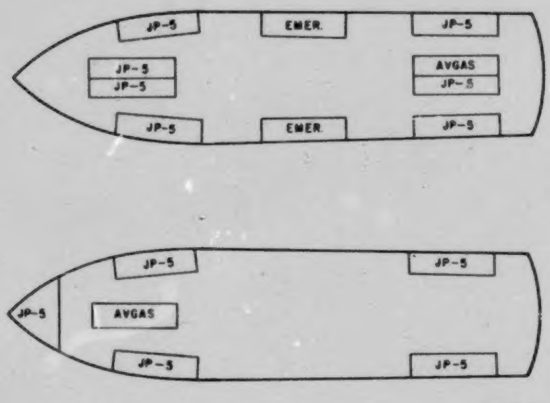

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Figure 3-7.—Ultimate fuel system (tank arrangement).

remaining. The clean, water-free JP-5 was then pumped from the service tanks through service filters on the 3rd deck to jet aircraft on the flight and hangar decks, via the port quadrant. The piping and valves were so arranged that either of the two existing pumps in each pumproom could be used for transfer or service in an emergency, but one pump in each pumproom was designated as a transfer pump and the other as a service pump.

When attack and fighter aircraft became predominantly jet-engined aircraft in the fleet, it was obvious that the CVA-class carriers required a maximum stowage and distribution of JP-5 and a limited stowage and distribution of aviation gasoline. The ultimate JP-5 System (CVA) conversion from the "interim" was a complex one. (See fig. 3-7.) The forward aviation gasoline pumproom was eliminated. The forward aviation gasoline stowage tanks were converted to JP-5 stowage and/or service tanks. The forward starboard aviation gasoline quadrant became a JP-5 quadrant. The after port aviation gasoline storage tanks were converted to JP-5 service tanks. The after starboard aviation gasoline quadrant remained the same, except for the removal of two aviation gasoline and two sea water pumps which were not required. This conversion gave a three-quadrant delivery of JP-5 and one of aviation gasoline.

The USS KITTY HAWK (CVA-63) was the first carrier constructed from the keel up with an original high capacity JP-5 fueling system. The type JP-5 system installed on this, and all newly constructed CVAs thereafter, has a four quadrant delivery of JP-5 and limited stowage and distribution of AvGas for servicing piston-type aircraft on the starboard side only. Except for the additional quadrant and minor changes to the distribution piping to incorporate a newly developed service station (Cla-Val), these systems are practically identical to and patterned after the CVA-59 conversions. No further information is given for this system here, as it is discussed in detail later in the chapter.

Not all "interim" systems were converted to the CVA system. The operational demand of our carrier fleet required low-speed, long-range, antisubmarine, hunter-killer type aircraft. At the present time, only reciprocating—engined aircraft meet this requirement. Therefore, it was necessary to modify some of the carriers with the "interim" systems which were ideally suited for this type assignment for a maximum stowage and distribution of aviation gasoline. This was accomplished by converting either quadrants 2 or 4 back to aviation gasoline quadrants. Carriers with this type system have a 3-quadrant delivery of aviation gasoline and one of JP-5. The JP-5 pumproom retained on this class carrier is identical to the one described under "Interim Aviation Fuel System."

Three of the original CVS's (USS BOXER, PRINCETON and VALLEY FORGE) were redesignated LPH (amphibious assault ships). The LPH was developed specifically to support the vertical envelopment phase of amphibious assault landings. No extensive changes were made to the aviation fuels systems. They remained basically the same as the CVS type system. These three ships are referred to as the LPH-4 Class.

Two additional type JP-5 fueling systems were introduced with the commissioning of the first newly constructed LPH-2 Class carrier and the first LPD-1 (landing transport dock). Although an LPD is not classified as an aircraft carrier in any sense of the word, it is capable of handling up to six helicopters and does require a complement of ABF's to operate and maintain the aviation fuel systems. In addition to the JP-5 and AvGas, a third system, AutoGas, is also installed on some ships with which the ABF is concerned.

The JP-5 fueling systems installed on the LPH-2 and LPD-1 Class are similar to the CVA in most respects. Except for size and capacity, the only noted difference is the arrangement of the service fuel filters. There is only one JP-5 pumproom serving one 5-inch quadrant distribution riser on each ship. Each pumproom contains two 220 gpm service pumps with maximum distribution capabilities of 400 gpm. The 400 gpm main fuel filter for the LPD is located in the JP-5 pumproom. The LPH-2 Class has one 300 gpm filter at each service station.

There are several different types of JP-5 fueling systems aboard aircraft carriers generally referred to by the class ship (CVA, CVS, LPH, LPD, etc.) on which installed. Each system may vary to some degree as to type, number, location and capacity of their component parts (such as pumps, filters, service stations, etc.), but most characteristics are similar. (The operational procedures are practically identical for all systems regardless of the class ship.)

This chapter covers a typical JP-5 fueling system (CVA) without reference to any particular ship. It encompasses the latest design and equipment on the most recent conversions and on all new CVA's, up to and including the CVA-66. Operational procedures are covered in chapter 4.

The purpose of the following section is to outline the basic differences in the various JP-5 systems and their component parts as to size, scope, and capacity. A general description of the entire system is given first; however, each part is covered in detail later in this and succeeding chapters.

GENERAL DESCRIPTION

A JP-5 fueling system consists primarily of a stowage system and three separate and independent pumping systems–Filling and Transfer, Stripping, and Service System. The tanks in a JP-5 system are designated under two major categories–stowage and service. Stowage tanks are used for bulk stowage of JP-5 and service tanks are used for servicing aircraft. The stowage capacity of the different class ships depends on the number and size of the tanks available. These will vary as the ships increase in size and class. The approximate stowage capacities for the different class ships are listed in table 3-1.

TRANSFER SYSTEM

Receipt and internal transfer of JP-5 aboard ship is accomplished by the filling and transfer system. JP-5 is received aboard in the same manner for all ships. Internal transfer from stowage to stowage and stowage to service tanks differs only in the number of transfer pumps and the type filtering equipment installed. CVA's have three 200-gpm transfer pumps in each of the forward and after pumprooms. LPH's and LPD's have only two each.

Table 3-1.—Stowage capacities

Class ship	Approximate capacity
LPD-3 (LA SALLE)	¼ million gallons
LPH-2 (IWO JIMA)	¼ million gallons
CVA-19 and 34 (HANCOCK & ORISKANY)	½ million gallons
CVA-41 (MIDWAY)	1 million gallons
CVA-59 (FORRESTAL)	1 ½ million gallons
CVA-63 (KITTY HAWK)	1 ¾ million gallons
CVA (N)-65 (ENTERPRISE)	2 ¼ million gallons
CVA-66 (AMERICA)	2 ¼ million gallons
CVA-67 (JOHN F. KENNEDY)	2 ½ million gallons

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The two types of filtering equipment (located between the transfer pumps and service tanks) presently being used in the transfer system are the 300 gpm transfer filters and the 200 gpm centrifugal purifiers. The transfer filters were the first to be used in the system. They are of the same type referred to in the interim system. Filters are rated at 300 gpm by the manufacturer, but were reduced to 200 gpm by the Navy to ensure a more efficient operation and longer life of the elements. The LPD-3 class has two filters of this type installed in their transfer system. The centrifugal purifier is replacing the transfer filters. They are designed to remove water and solids by centrifugal force. CVA's and LPH-2 Class carriers have two purifiers in each JP-5 pumproom. Regardless of the type filtering equipment installed, the maximum pumping rate from stowage to service tanks is 400 gpm per pumproom for all systems.

STRIPPING SYSTEM

The motor-driven stripping system is used to remove water and sludge and to completely empty the tanks. The arrangement of this system is basically the same for all ships. CVA's and the LPH-2 Class carriers have two stripping pumps in each JP-5 pumproom. The LPD-3 Class has only one stripping pump.

SERVICE SYSTEM

Of the three different pumping systems that make up a JP-5 fueling system, the most noted differences will be found in the service system. The arrangement of this system not only differs for the different class ships but also within each class, depending on the type service station installed. The service system encompasses all piping, valves, and related equipment (such as pressure regulator, service fuel filter, and service stations necessary to safely deliver the cleanest possible fuel from the service tanks to the aircraft). The number and size of the quadrant distribution risers and the distribution capabilities of the different class ships are shown in table 3-2.

PUMPS

Pumps in the JP-5 pumprooms are divided into three major categories—service, transfer, and stripping. The most common service pump used in the fleet is the centrifugal type. There are three different capacities:

1,100 gpm (on CVA-59 Class and up)
675 gpm (on CVA-43 and below)
220 gpm (on LPH's and LPD's)

The most common transfer pumps used in the various systems are the rotary-vane and rotary gear with a rated capacity of 200 gpm at 50 psi.

There are two types of stripping pumps in use in the JP-5 system—the rotary-vane type with a capacity of 50 gpm at 50 psi, and the internal rotary gear with a capacity of 46 gpm at 50 psi.

Table 3-2.—JP-5 distribution capabilities

Class carrier	Number quadrants	Size quad. dist. riser	No. pumps per quadrant	Capacity ea. pump	Capacity ea. quadrant
LPD-3	1	5 in.	2	220 gpm	400 gpm
LPH-2	1	5 in.	2	220 gpm	400 gpm
CVA-19	3	6 in.	2	675 gpm	1,200 gpm
CVA-34	3	6 in.	1	1,000 gpm	900 gpm
CVA-41 and 42	3	6 in.	2	675 gpm	1,200 gpm
CVA-43	4	6 in.	2	675 gpm	1,200 gpm
CVA-59, 60, 61 and 62	3	8 in.	2	1,100 gpm	2,000 gpm
CVA-63-67	4	8 in.	2	1,100 gpm	2,000 gpm

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PRESSURE REGULATOR

There is an automatic pressure-regulating system installed in each JP-5 quadrant distribution riser except on carriers equipped with the Cla-Val fuel/defuel valve type service stations. The pressure regulator maintains a constant regulated pressure in the quadrant at all rates of flow. The regulating systems are identical for all class carriers except for their physical size and pressure setting. The size of the distribution riser determines the size of the regulating system required, either 6-inch or 8-inch. The pressure setting will vary for the individual ship. This will depend on the size and length of the piping in each quadrant and the type service station installed; i.e., Blackmer, or Wheeler.

SPARLING FLOWMETERS

Originally, there was one Sparling flowmeter installed in each quadrant distribution riser. This meter is no longer installed in the JP-5 system. However, they are still used in the AvGas system, and are discussed in chapter 5 of this manual.

SERVICE FUEL FILTERS

All CVA's have one service fuel filter installed in each quadrant distribution riser located outboard at the third deck level. There are two different capacities of filters in the JP-5 system on CVA's, 1,200 gpm on ships with 6-inch distribution piping, and 2,000 gpm on ships with 8-inch piping. The LPH-2 Class has one 300 gpm filter installed at each JP-5 service station. LPD's have only one 400 gpm filter located in the JP-5 pumproom. Regardless of the number, capacity, and location, all main fuel filters are designed for the same purpose—to remove water and solids from the JP-5 just prior to entering the aircraft. Except for their physical size and shape, all filters are basically the same.

SERVICE STATIONS

In the past, there were four fueling stations used in the fleet; Wayne, Wheeler, Blackmer, and Cla-Val fuel/defuel valve.

At the time the Cla-Val station is the most widely used and is being installed on all new construction; the Blackmer and Wheeler are the only other stations that are still in use. The

Cla-Val and Blackmer stations are the only ones discussed in this manual. NOTE: The USS Midway, CVA-41, is the only ship with Wheeler-type fueling stations.

SYSTEM COMPONENTS

TANKS

Stowage of aviation fuel aboard carriers has always presented a serious fire and explosion hazard. With the introduction of JP-5 as the primary jet fuel, hazards in handling were lessened and, because of the high flashpoint of JP-5 (minimum 140 degrees F), protective stowage is not required.

Basically, there are four types of JP-5 tanks–wing, deep centerline, double-bottom, and peak tanks. See figure 3-8 for the types and locations of JP-5 tanks.

Tank names generally relate to the relative location of the tanks in respect to the hull of the ship. Shield tanks are located around the reactors on nuclear-powered carriers.

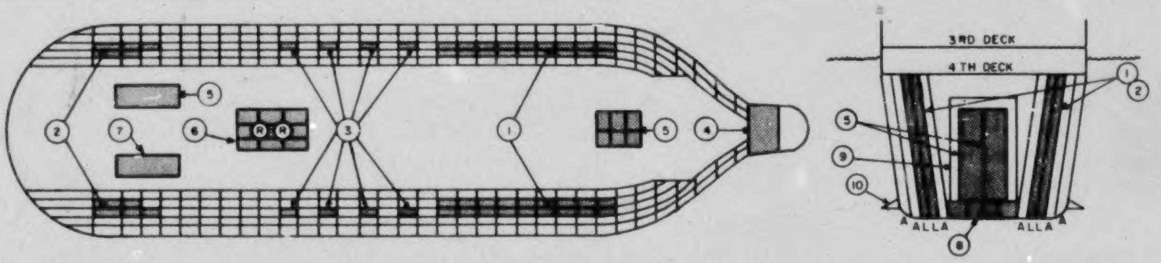
Wing tanks are deep tanks which are located in a fore and aft row along the contour of the hull on the port and starboard sides of the ship. There are normally two rows of wing tanks on each side. These tanks are located between voids and are an integral part of the ship's underwater protective system. The top of the tank is at the fourth deck level and the bottom is the shell of the ship. There is an equal number of port and starboard wing tanks in the forward group and in the after group. Each port tank has an identical twin of the same shape and capacity located directly opposite on the starboard side. These twins are operated as a unit; that is, they are filled and emptied as if they were one tank to preserve the list and trim of the ship.

Deep centerline tanks referred to here were the original AvGas tanks on CVA's that were converted to JP-5 tanks. Normally, all forward tanks and the after port tanks were converted. The cofferdams for the converted tanks are either filled with fresh water or utilized as service or stowage tanks.

Seagoing vessels have two bottoms; a bottom and an inner bottom. The space between double bottoms is divided into many watertight compartments which are used for stowage of fuel, water, or ballast. These are called double-bottom tanks. The bottom of these tanks is the bottom or outer shell of the ship. The top of these tanks is the inner bottom which is also the deck of the bilge. Double-bottom tanks are, by necessity, shallow tanks.

Peak tanks are deep tanks which are located in the extreme bow and stern of the ship below the waterline. Only the bow tanks are used for JP-5 stowage at the present time. The shell of the ship forms two sides and the bottom of each peak tank.

JP-5 tanks are designed and constructed to fulfill specific purposes and are classified under



1. JP-5 wing tanks (forward group).
2. JP-5 wing tanks (after group).
3. Amidships emergency tanks (wing tanks).
4. Peak tanks.
5. Deep centerline tanks.
6. Shield tanks (nuclear-powered carriers only).
7. AvGas saddle tanks.
8. Double-bottom tanks.
9. Cofferdam (filled with fresh water).
10. Bilge keel.

A. Air.
L. Liquid.
R. Reactor.

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Figure 3-8.–Types of JP-5 tanks.

two major categories—STOWAGE and SERVICE. A stowage tank is any tank used for the bulk stowage of JP-5. Any wing, deep centerline, double-bottom, or peak tank can be used for bulk stowage. A service tank is any tank used for stowage of JP-5 suitable for issue to aircraft. The JP-5 in a service tank has been passed through either a filter or a centrifugal purifier prior to being pumped into the service tank. Generally, only wing or deep centerline tanks are used for this purpose. Service tanks have but one purpose, servicing aircraft, but stowage tanks can be used for several purposes. The designation of each tank indicates all the functions performed by that tank. Table 3-3 lists the normal designations and utilizations of stowage tanks.

JP-5 Stowage Tanks

A typical JP-5 stowage tank with associated piping is shown in figure 3-9. Each JP-5 stowage tank and the piping within the tank are coated with DEVRAN or its equivalent (a special type paint applied to the interior of each tank) to minimize rust formations.

An air escape riser which vents the tank to the atmosphere extends from the top of the tank to an air escape main that runs fore and aft just below the main deck. The air escape riser (vent line) prevents a buildup of pressure when the tanks are being filled and prevents a vacuum from forming when the tanks are being emptied.

There are usually four air escape mains serving the forward and after groups of tanks—two forward (one port and one starboard) and two aft (one port and one starboard). A cane-shaped vent line extends up from each main to just below the 02 level and loops back down to just below the 01 level where it terminates in a can. One end of the can, which contains a flame arrester, penetrates the skin of the ship and is open to atmosphere. The outboard end is covered with a ratproof screen and the inboard end is closed by an inspection plate. The flame arrester is cleaned quarterly. CAUTION: The ship's side cleaners should be cautioned about spray painting in the immediate vicinity of these vents. Sprayed paint can stop the flow of air through the vents by clogging the flame arrester.

An overflow line extends from near the top of the stowage tank to an overflow tank. This line is considerably larger than the tank fill line to prevent rupture of the stowage tank in the event of overfilling at high pressure. A one-way check valve in the overflow line ensures that when the tank is full it will overflow into an overflow tank and not into another stowage tank.

A bolted manhole cover provides access to the tank for inspection, cleaning, and maintenance.

A sounding tube extends from the extreme bottom of the tank to the second or third deck. The lower end is secured to a striker plate and the upper end is closed by a threaded access cap. That section of the sounding tube within the tank has evenly spaced holes to ensure that the level of the fuel in the tube is the same as that in the tank. Sounding tubes are provided for measuring the quantity of JP-5 in the tank, detecting water, and thiefing a sample.

Each JP-5 tank is provided with a remote-reading liquid level indicator. The gages which measure the amount of JP-5 in gallons are located near the tank manifold valves.

Table 3-3.—Tank designations and utilizations

Tank designations	Utilizations
JP-5	Bulk stowage of JP-5 only.
JP-5 or overflow	Bulk stowage of JP-5, and receives the overflow from tanks designated JP-5.
JP-5 or ballast	Bulk stowage of JP-5, and is ballasted (filled with sea water) when the tank is emptied of JP-5.
JP-5 overflow or ballast	Bulk stowage of JP-5, ballasted when empty of JP-5, and receives the overflow from tanks designated JP-5 or ballast.

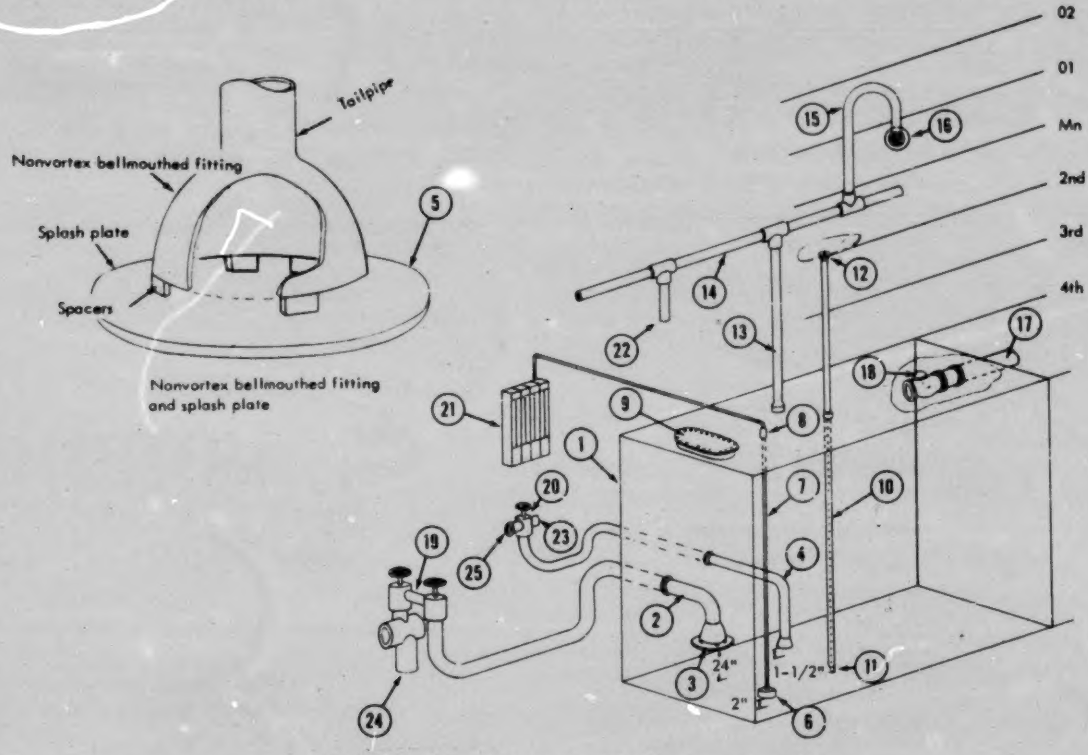
The suction and fill tailpipe extends from the manifold to a minimum of 24 inches off the bottom at the lowest end of the tank. A nonvortex bellmouthed fitting and a splash plate are installed on the end of the tailpipe. This fitting reduces turbulence when filling, prevents a vortex from forming when emptying the tank, and also prevents taking a suction directly off the bottom. Stowage tanks are filled and emptied through this line.

The stripping tailpipe is similar in design to the suction and fill tailpipe except that it is smaller in size and has no splash plate. This line extends from the stripping manifold to a maximum of 1½ inches off the bottom at the lowest end of the tank. The stripping tailpipe is used to remove water and sludge from the bottom of the tank, and to completely empty the tank by removing the last 24 inches of usable JP-5 when consolidating the fuel load. The stripping tailpipe is also used when ballasting and deballasting the stowage tanks.

NOTE: JP-5 stowage tanks have a filling rate of 500 gpm per tank, with the required minimum of six tanks on the line.

JP-5 Overflow Tanks

Overflow tanks (fig. 3-10) have basically the same fittings previously described for the



Nonvortex bellmouthed fitting and splash plate

1. Tank.
2. Fill and suction tailpipe.
3. Nonvortex bellmouthed fitting and splash plate.
4. Stripping tailpipe.
5. Nonvortex bellmouthed fitting.
6. Air bell.
7. Tank downpipe.
8. Tank top plug and box assembly.
9. Manhole (tank access).
10. Sounding tube.
11. Striker plate.
12. Sounding tube cap.
13. Air escape riser.
14. Air escape main.
15. Air vent.
16. Flame arrester.
17. Overflow line.
18. One-way check valve.
19. Suction and fill manifold.
20. Stripping manifold.
21. Gage panel (liquid level indicator).
22. Connection to other tank air escape risers.
23. Connection to other tank valves.
24. Connection to transfer main branch header.
25. Connection to flood and drain manifold.

Figure 3-9.—Typical JP-5 stowage tank. 197.40.1

stowage tanks, except for the large overflow line and the arrangement of the vent line. In addition to serving as a regular stowage tank, they are also designed to receive the overflow from the other stowage tanks in their respective nest.

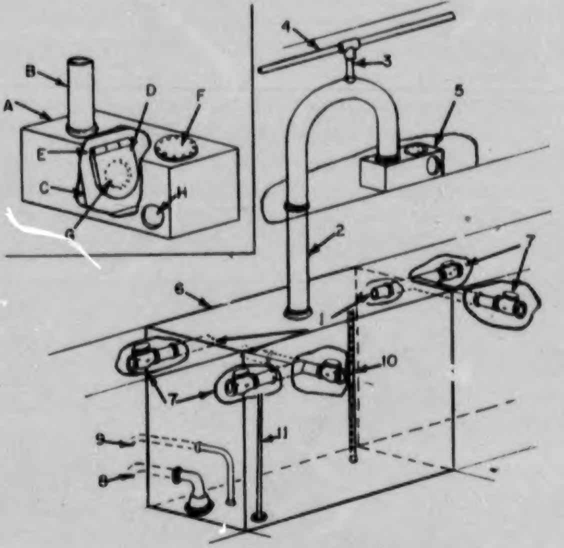
NOTE: A nest of tanks is that small unit of tanks within a group of tanks that is serviced by one overflow tank. The forward and after groups of stowage tanks consist of several nests of tanks.

The overflow tanks are actually a safety feature to prevent rupturing stowage tanks in the event they are overtaxed (pressurized excessively) during a filling operation. The overflow tanks overflow overboard when they are full. The large overflow line extends up from the top of the tank to just below the second deck. Here it loops back down and discharges into an overflow box on the third deck. The overflow box contains a flapper check valve that allows JP-5 to be discharged overboard but prevents sea water from entering the tanks. An inspection plate located directly over the valve allows access for cleaning and maintenance. In the past, flapper check valves have frozen open due to corrosion, and sea water contamination of JP-5 has resulted. These valves must therefore be inspected at least every 6 months (more often if necessary).

The overflow tanks are vented via an air escape riser from the top of the loop in the overflow line to one of the common air escape mains. Overflow tanks are the last tanks to be filled when receiving JP-5 aboard and are the first tanks to be emptied when transferring internally.

Amidship Emergency Service Tanks

There are eight wing tanks (4 port and 4 starboard) located amidships which are used for emergency issue of JP-5 to the engineers for use as boiler fuel. These tanks are so located that there is one port and one starboard tank outboard of each of the four main enginerooms. The amidship tanks are primarily voids and are an integral part of the Damage Control Underwater Protective System. JP-5 for aviation use is NEVER stowed in these tanks. Once JP-5 is pumped into these tanks, it becomes the property of the Engineering Department and is no longer considered as being aviation fuel and WILL NOT be used as such.



- **A. Overflow box.**
- **B. Overflow line.**
- **C. Dividing bulkhead.**
- **D. Flapper check valve.**
- **E. Hinge.**
- **F. Access cover.**
- **G. Hole through dividing bulkhead.**
- **H. Hole through ship's skin.**
- **1. Overflow from stowage tanks in nest.**
- **2. Overflow line.**
- **3. Air escape riser.**
- **4. Air escape main.**
- **5. Overflow box.**
- **6. Overflow tank.**
- **7. One-way check valves.**
- **8. Fill and suction tailpipe with nonvortex fitting.**
- **9. Stripping tailpipe.**
- **10. Sounding tube.**
- **11. Tank downpipe with air bell (liquid level indicator).**

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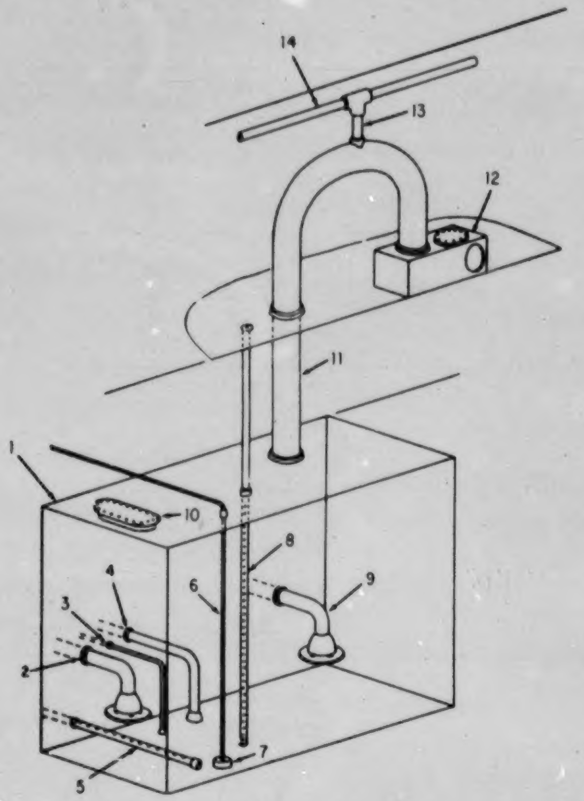
Figure 3-10.—Typical JP-5 overflow tank.

On newer carriers, emergency service tanks are not required. If JP-5 is needed for emergency boiler fuel it is pumped directly to the fuel oil service tanks.

JP-5 Service Tanks

Although much of the equipment in the service tanks (fig. 3-11) is similar to that described in the stowage and overflow tanks, the



1. **Service tank.**
2. **Filling tailpipe with nonvortex fitting.**
3. **Hand pump stripping tailpipe.**
4. **Motor-driven stripping pump tailpipe.**
5. **Horizontal recirculating line.**
6. **Tank downpipe (liquid level indicator).**
7. **Air bell.**
8. **Sounding tube.**
9. **Suction tailpipe with nonvortex fitting.**
10. **Tank access manhole.**
11. **Overflow line.**
12. **Overflow box.**
13. **Air escape riser.**
14. **Air escape main.**

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Figure 3-11.–Typical JP-5 Service Tank.

piping arrangement is different and additional equipment is required.

Service tanks have an independent filling tailpipe and an independent suction tailpipe. The filling tailpipe extends from the common discharge header of the transfer filtering media in the JP-5 pumproom to a minimum of 24 inches off the tank bottom. Service tanks are NEVER filled directly from a tanker, barge or pier. They are always filled from settled stowage tanks only via the transfer filtering media. The suction tailpipe extends from the service pumps common suction header to a minimum of 24 inches off the tank bottom in the opposite end from the fill line. A shut-off valve is installed in this line between the service pump common suction header and the service tank. Two independent stripping systems, one hand operated and the other motor-driven, are installed in each service tank. The tailpipe for the hand operated stripping pump extends from a maximum of three-fourths inch off the service tank bottom to the hand operated pump in the pumproom. The tailpipe for the motor-driven stripping pump extends from a maximum of 1½ inches off the tank bottom to the common suction header of the motor-driven stripping pumps. This line is equipped with a shutoff valve and a one-way check valve. Service tanks are NEVER ballasted with sea water; therefore, no provisions are made for this purpose. The motor-driven stripping system for service tanks is primarily used to completely empty the tanks and to remove the wash water after a cleaning operation. (Use of detergents in wash water is forbidden.) A recirculating line is installed horizontally 18 inches off the tank bottom in the opposite end from the suction tailpipe. This line provides a means of returning to the service tank the recirculated fuel from the discharge side of the service pump and the pressure regulator (when installed). A number of 1-inch holes, equally spaced along the top of the recirculating line allow JP-5 to be returned to the tank without disturbing the contents of the tank. Foaming is minimized since the recirculating line is always covered with JP-5.

Tank Inspection and Cleaning

Each JP-5 stowage and service tank must be emptied, opened, and inspected at least once every 6 months.

CAUTION: No person is to enter any JP-5 tank for inspection or cleaning until the conditions for safe entry specified by the Gas-Free Engineer (or his authorized representative) have been strictly complied with.

If the inspection reveals that bulkheads, stiffeners, and flat surfaces have collected solids to the extent that they are readily visible, the tanks are washed with sea water from a firehose. Wash water is removed from stowage tanks designated JP-5 or ballast by the main drainage eductor, and from service tanks and stowage tanks (designated JP-5 only) by the JP-5 motor-driven stripping pumps.

The above procedures are followed if the operation is conducted at sea. If conducted in port, assistance by a shore activity and changes in the wash water removal procedure are required to prevent harbor pollution.

Due to the ease with which deposits can be washed out of JP-5 tanks with a firehose, steaming is not required nor should it be employed since the tank coatings may be damaged.

JP-5 tanks are never cleaned by the chemical cleaning processes using solvent-emulsifier type compounds. Small quantities of the chemical type cleaners remaining in the tanks will contaminate the coalescer elements in the filter/separator and destroy their coalescing ability.

When conducting the inspection and cleaning of JP-5 tanks, refer to applicable Maintenance Requirements Cards for correct procedures and safety precautions to be followed.

LIQUID LEVEL INDICATORS

Each JP-5 tank is provided with a remote-reading liquid level indicator, regardless of the type of tank. These indicators are known by various names; such as, King Gages, Meriam Gages, Static Head Liquid Level Gages, etc. Three types presently being used aboard ship are:

1. Hand pump model (three tube system).
2. Compressed air model (two tube system).
3. Compressed air model (one tube system).

The theory of operation of all three models is basically the same—they weigh the JP-5 in the tank and indicate the amount in gallons. They are, in reality, a frictionless-balance which is hydrostatic in operation and is based on the "U" tube principle. There are no floats, gears, diaphragms, springs, electrical components, or other moving parts; therefore, there is no loss of accuracy over years of use.

The "U" tube is more nearly perfect than any other pressure-measuring device, being free from all moving mechanical parts which can wear or lose their adjustments. The hydrostatic head of JP-5 being measured is exactly balanced by the rise of gage liquid. Accuracy of one-half of one percent can be obtained with the liquid level indicators. The accuracy of the reading depends on four factors:

1. Proper engineering of gage installation.
2. The accuracy with which the gage scale is graduated.
3. The specific gravity used to calibrate the scale.
4. The degree of care with which the operator takes readings.

To understand the operation of the liquid level indicators, one must understand the following two principles:

1. Volume changes due to rise or drop in temperature.
2. Weight does NOT change with temperature variations.

EXAMPLE: At 60°F 1 gallon of JP-5 with an API of 40 weighs 6.870 pounds, and occupies 231 cubic inches. If the JP-5 temperature rises to 90° F, it will expand and occupy 234 cubic inches but the weight of the fuel remains the same.

The scales are calibrated in feet and inches of height of the tank and in gallons for each foot increase of tank height.

The scale graduated in feet and inches is based on the mean specific gravity of JP-5 at 60° F. JP-5 specific gravity varies from 0.788 to 0.845. The mean is 0.8165. The error of readings resulting from the fluid in the tank having a specific gravity of 0.788 or 0.845 will be +3.5 percent.

The pressure created by the height of the liquid in the tank (the hydrostatic head), acting against the air trapped in the tank downpipe, is transmitted through the pressure line to the indicating liquid in the liquid well. This pressure, being applied to the top of the indicating liquid, forces the liquid down in the liquid well (reservoir) and up into the gage glass where the reading is taken. The result is, in effect, a frictionless-balanced scale; where the unknown weight of the liquid (the hydrostatic head) in the tank is exactly balanced against the known weight of the liquid in the "U" tube.

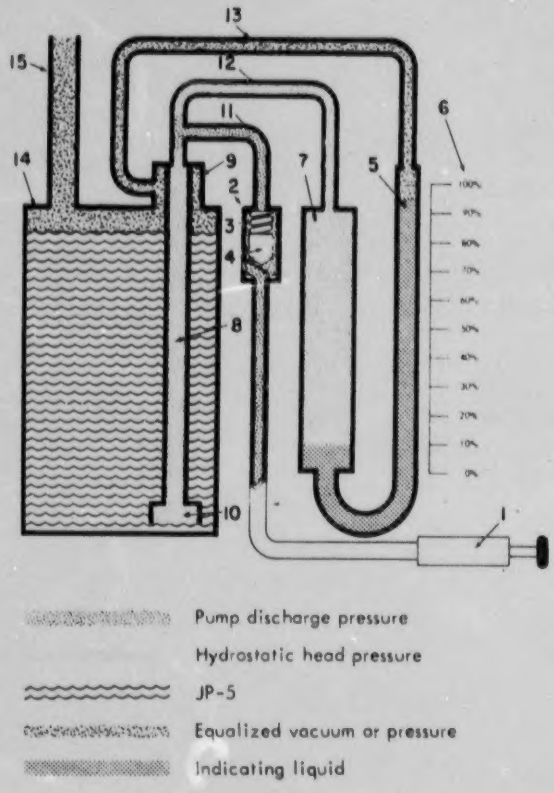
Hand Pump Model (Three Tube System)

The Hand Pump Model (three tube system) (fig. 3-12) was the first type to be installed in JP-5 tanks and will be found only in the JP-5 systems on some of the older carriers. However, it is used on all ships for measuring the quantity of liquid in the cofferdams surrounding the aviation gasoline tanks. This system consists of three main parts: gage, tank downpipe, and connecting tubing.

The gage, located near the tank manifold valves, houses the pump, "U" tube (gage glass and liquid reservoir), and gage scales. The pump, mounted in the base of the gage, serves a two-fold purpose; it is used to blow the JP-5 out of the downpipe and provides the working medium (air) between the JP-5 in the tank and the indicating liquid in the reservoir. It consists of a spring-loaded plunger with a self-lubricated leather seal. A spring-loaded check valve assembly, installed in the discharge line, prevents the loss of air back through the hand pump. The check valve contains a compression spring, sliding piston, and a silicone rubber seat. The gage glass, which forms one side of the "U" tube, is mounted at the front of the gage and provides a visible means of determining the height of the indicating liquid. Two scales, one on each side of the gage glass, are set at a 15° angle to the front cover in a plane passing through the gage glass. The angle mounting eliminates glare and parallax. The scales are white enamel with black graduations. One scale is calibrated in gallons and the other in inches of indicating liquid. The scales are exactly calibrated for each individual tank upon installation and are not interchangeable. Gages are identified on the gage panel by a label plate installed directly above each gage, giving the tank number and tank contents.

The reservoir, which holds the indicating liquid, forms the bottom and the other side of the "U" tube. There are three types of indicating liquid used:

1. Mercury is used for tanks which have a depth of over 10 or 12 feet. The mercury used has a specific gravity of 13.546 and is approximately 13.6 times as heavy as water. The scale used with mercury will measure depths of water 14 times its own length.
2. No. 294 Red Liquid (acetylene tetrabromide) is used for tanks which have a



1. Hand pump.
2. Spring-loaded air-check valve assembly.
3. Spring.
4. Piston and silicone rubber seat.
5. Gage glass.
6. Scale.
7. Liquid well (reservoir).
8. JP-5 tank air bell.
9. Tank top plug and box assembly.
10. JP-5 tank air bell.
11. Pump line.
12. Pressure line.
13. Equalizer line.
14. JP-5 tank.
15. JP-5 tank vent.

198.10

Figure 3-12.—Hand pump model (three-tube system).

depth of up to 10 or 12 feet. This indicating liquid has a specific gravity of 2.940 and is approximately 3.0 times as heavy as water. The scale used with the No. 294 Red Liquid will measure depths of water three times its own length.

3. No. 120 Green Liquid (alpha chlornapthalene) is used for tanks which have a depth of up to 5 feet. It has a specific gravity of 1.200 and is approximately 1.2 times as heavy as water. The scale used with the No. 120 Green Liquid will measure depths of water 1¼ times its own length.

The tank downpipe is a ¾-inch pipe that extends from the tank top plug and box assembly to the air bell located 2 inches off the tank bottom. This line transmits the hydrostatic head pressure of the JP-5 in the tank to the pressure line attached to the gage. The tank top plug and box assembly provides a compact means of attaching the air lines from the gage to the tank and tank downpipe. The indicator gage and tank are interconnected by three air lines—pump line, pressure line, and equalizer line. The pump line connects the discharge of the hand pump to the tank downpipe. The pressure line connects the top of the liquid reservoir to the top of the tank downpipe. This line transmits static head pressure of the JP-5 in the tank downpipe to the indicating liquid. The equalizer line connects the top of the tank to the top of the gage glass. This line equalizes any pressure or vacuum between the two points. The volume of air required to operate the three tube systems is kept to a minimum by using small bore (0.050 inch ID) capillary tubes. All three tubes are encased in a 3/8-inch diameter flame-resistant, waterproof, flexible armored cable. All extension joints between the gage and tank are silver-soldered and tested at 100 psi. Tank and gage connections are made tight with the application of litharge and glycerin on the threaded fittings.

OPERATION OF THE HAND PUMP MODEL.—Operate the hand pump four or five times SLOWLY to expel any liquid from the tank downpipe that may have entered due to contraction of air in the system. If liquid is in the downpipe, the indicating liquid will rise rapidly in the gage glass. Stop pumping immediately, as there is danger in blowing the indicating liquid out the top of the gage. This rapid rise of liquid in the gage glass is caused by the back pressure developing since a cold or heavy liquid cannot be immediately expelled from the downpipe with the first few strokes of the pump. Wait a few seconds until the liquid settles and then pump again until the liquid rises half way up the gage. If the liquid drops sharply after the second pumping, repeat the pumping operation until the liquid no longer rises rapidly and two consecutive equal readings are obtained. These are then the correct reading.

The excess air pumped into the tank after the liquid has been removed from the tank downpipe will bubble up through the JP-5 and escape to atmosphere via the tank vent line. The system will remain full of air due to the closing of the air check valve in the pump discharge line. The pressure of the trapped air in the system is increased by the weight (hydrostatic head) of the JP-5 in the tank. This increased pressure is transmitted to the top of the reservoir via the pressure line forcing the indicating liquid up into the gage glass in proportion to the hydrostatic head of JP-5.

MAINTENANCE AND TROUBLESHOOTING (HAND PUMP MODEL).—If the indicating liquid in the gage glass does not drop to the bottom line on the scale when the tank is known to be empty, the probable cause may be:

1. Foreign matter blocking the air line tube.
2. Too much indicating liquid in the reservoir.

The cause may be determined by disconnecting the three air line tubes at the top of the gage. If the indicating liquid drops in the gage glass, it is an indication that the tubes are blocked and must be blown out with dry air. When using the ship's low-pressure air system, use a calcium chloride dryer to dry the air. If the indicating liquid does not drop or remains above the first mark on the scale, it is an indication of too much liquid in the reservoir. Remove the excess liquid by the drain plug at the bottom of the gage. If the indicating liquid falls below the first mark on the scale, add additional liquid through the center connection. Use an eye dropper when adding red or green liquid and a paper funnel for mercury.

When filling the gage with mercury never allow the mercury to come in contact with any metal except iron and steel, as it immediately mixes with other metals; thus spoiling the mercury for other use. If the mercury is left in contact with other metals for a sufficient length of time the latter will disintegrate. When mercury is not in use it must be kept in a stoppered glass, iron, or earthen container. Never use commercial or dirty mercury. Mercury can be cleaned by forcing it through a clean chamois skin.

If the indicating liquid does not stay up in the gage glass after operating the hand pump, and JP-5 is known to be in the tank, the cause is probably an air leak. There are normally three places to look for an air leak: a loose nut at the air line connections, a soldered joint, or a leaking air check valve assembly. Use a soap solution when testing for leaks and operate the hand pump to supply the necessary air. Check gage connections first and then the tank.

If the indicating liquid fails to rise slightly when the gage is pumped, after it has stood idle for at least 12 hours, and it is known that there is more JP-5 in the tank than the gage indicates, the cause is probably:

1. The hand pump is not delivering air.
2. The air check valve assembly is clogged.
3. One of the air lines is clogged.

Check the pump first by disconnecting the pump line (the right-hand connection at the top of the gage). If air fails to discharge through this connection after operating the pump, replace the pump leather and/or the check valve assembly.

Cautions to be taken when performing maintenance on the gage:

1. Never disconnect the air line tubes (either at the tank or at the gage) if there is any pressure on the tank.

2. Never permit dirt or moisture to enter the gage or gage line during maintenance work.

3. Use only DRY air when blowing out gage lines. Calcium chloride dryers can be constructed onboard. They consist basically of a piece of 1½ inch copper tubing approximately 15 inches long filled with calcium chloride. The discharge end is packed with cotton to prevent blowing the calcium chloride out of the tubing. Each end is closed by threaded caps fitted with tubing connections.

4. Always use a soap solution when testing for leaks.

Compressed Air Model (Two Tube System)

The compressed air models operate on the same theory as the hand pump model. Many of the component parts are basically the same. The major difference is the method used in supplying air for its operation. These systems utilize the ship's low-pressure air system, eliminating the need for the hand pump and pump line. With the utilization of the ship's low-pressure air system for the air supply, additional equipment is required to clean, dry, and control the airflow to the gages. (See fig. 3-13.)

The air supply line leading off the ship's low-pressure air system to the gage panel board contains an air filter and separator , an air reducing valve, and a pressure gage. This line also supplies air to other gage panels in the system.

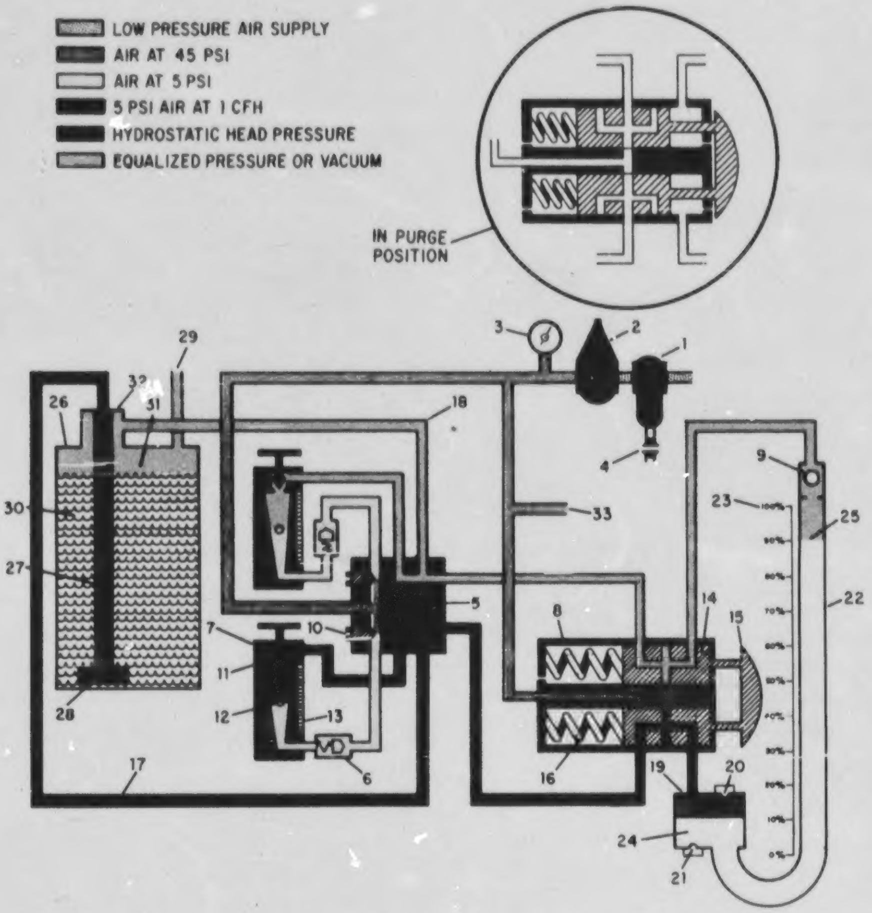
The air filter and separator filters out dirt and separates moisture from the incoming air. It contains a renewable filter element that is replaced semiannually. The separator is drained daily through the petcock installed in the bottom of the air filter and separator.

The air reducing valve is a spring-loaded, diaphragm-operated valve. It is set to reduce the ship's low-pressure air to 45 psi.

The pressure gage provides a means of accurately setting the reducing valve and indicates the air pressure being supplied.

Each gage on the panel board contains the following additional equipment: a duo-snubber manifold assembly, an air check valve assembly, two rotometers, a duo-purge valve, and a vent-check valve. The duo-snubber manifold assembly provides a compact means of interconnecting the low-pressure air supply, rotometers, equalizer line, pressure line, and the duo-purge valve. Two duo-snubber plugs are incorporated in the manifold to further reduce the air pressure to the rotometers from 45 psi to 5 psi.

The air check valve assembly, located at the inlet to each rotometer, is a spring-loaded, sliding piston type valve with a silicone rubber seat. The valves are spring-loaded to close. They


LOW PRESSURE AIR SUPPLY
AIR AT 45 PSI
AIR AT 5 PSI
5 PSI AIR AT 1 CFH
HYDROSTATIC HEAD PRESSURE
EQUALIZED PRESSURE OR VACUUM
IN PURGE POSITION
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%

1. Air filter and separator.
2. Air reducing valve.
3. Pressure gage.
4. Drain cock.
5. Duo-snubber manifold assembly.
6. Air check valve.
7. Rotometers.
8. Duo-purge valve.
9. Vent check valve.
10. Duo-snubber plugs.
11. Needle valve.
12. Nylon ball.
13. Scale.
14. Pistons (two).
15. Knob assembly.
16. Spring.
17. Pressure line.
18. Equalizer line.
19. Liquid well.
20. Fill plug.
21. Drain plug.
22. Gage glass.
23. Scale.
24. Indicating liquid.
25. Level of indicating liquid corresponding to 90% full.
26. Tank.
27. Tank downpipe.
28. Air bell.
29. Tank vent.
30. JP-5.
31. Level of JP-5 in tank at 90% full.
32. Tank top plug and box assembly.
33. Connection to other liquid level indicator on the panel board.

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Figure 3-13.—Compressed air model (two-tube system).

allow air under pressure to flow from the duo-snubber manifold up through the rotometers during normal operation, but prevent a loss of air out of the system in the event the low-pressure air supply is cut off. They also prevent a backflow through the system during the purging operation.

The two rotometers (one in the pressure line and the other in the equalizer line) serve to meter the flow of air to 1 cfh (cubic foot per hour). Airflow through the rotometer is controlled by the needle valve. The rate of flow is measured by the nylon ball located inside the tapered tube and a numbered scale etched on the outer surface of the housing. The faster the flow, the higher the nylon ball floats on the column of air. The scale is read at the height of the nylon ball. The housing is made of clear plastic, allowing the ball to be seen.

The duo-purge valve is a two-position, spring-loaded piston-type valve. It contains two pistons working side by side in a single housing. The two pistons are connected externally to the knob assembly, thereby working together as a unit. The two positions of the valve are NORMAL and PURGE. Figure 3-13 shows the valve in the NORMAL position. It is held in this position by the spring.

In the NORMAL position, the duo-purge valve directs air from the rotometers via the pressure line and equalizer line to the top of the liquid well and to the top of the gage glass.

In the PURGE position, shown in the inset (fig. 3-13), the duo-purge valve isolates the gage from the rest of the system and directs low-pressure air at 45 psi through the pressure line, equalizer line, and tank downpipe.

The vent check valve is a ball type check installed at the top of the gage glass. It is an added safety feature that vents the gage glass and also prevents the indicating liquid from being blown out the top.

The equalizer lines and pressure lines in the compressed air model are either three-eighths or one-half inch O.D. tubing.

OPERATION OF THE COMPRESSED AIR MODEL.—The ship's low-pressure air enters the air filter and separator where it is cleaned and dried. It is then reduced to 45 psi and piped to the various gage panels in the pumproom concerned. (The rest of this operation deals with only one gage and one tank.) Clean, dry air at 45 psi enters the duo-snubber manifold assembly, where it is further reduced to 5 psi. This lower pressurized air is then directed to the inlet (bottom) of both rotometers. The flow rate through the rotometers is adjusted by the needle valve on top to 1 cfh (cubic foot per hour). Both nylon balls should be at the "1" mark on the indicating scale. (Both rotometers MUST read the same for proper operation of the valve.) It is not mandatory that they be adjusted to 1 cfh, as the gage could operate on a higher or lower flow rate, but it is a MUST that both rotometers read the same. The rotometers are normally adjusted to 1 cfh for conservation of the ship's low-pressure air. Air leaving the rotometers is directed back to the duo-snubber manifold where they are interconnected with their respective gage lines, pressure line and equalizer line. The pressure line connects the tank downpipe to the top of the indicating liquid reservoir. The equalizer line connects the top of the tank with the top of the gage glass.

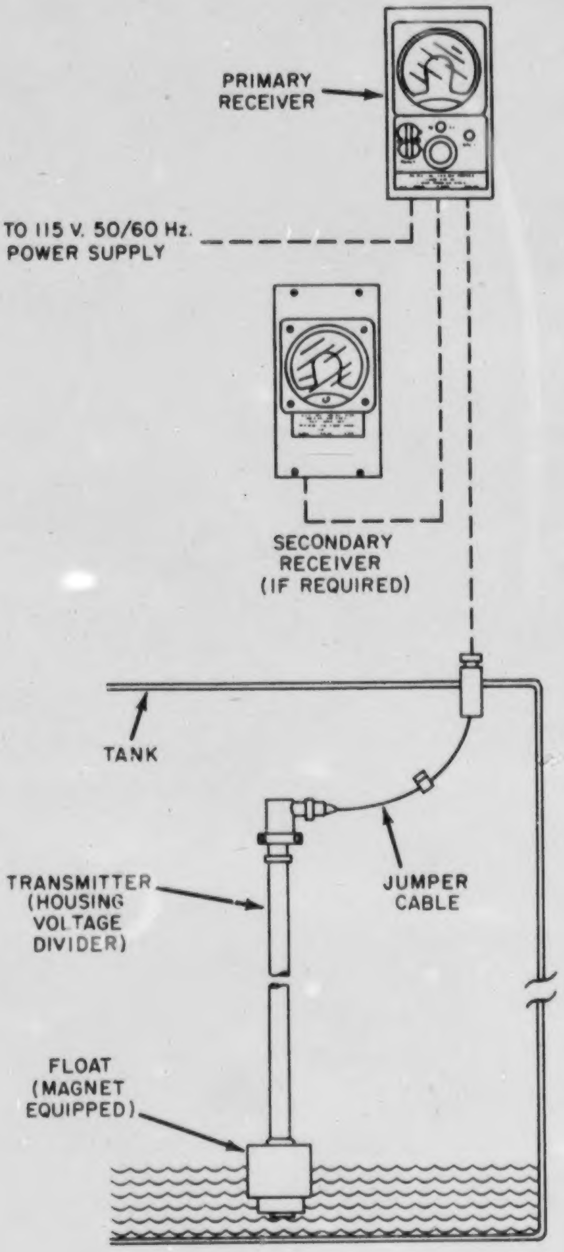
It must be remembered that as long as the system is in operation, air continually flows to the tank downpipe. Resistance to this flow, caused by the static head pressure of the JP-5 in the tank, is applied to the indicating liquid in the reservoir, forcing it up in the gage glass in proportion to the amount of JP-5 in the tank. The same amount of air is also being directed to the equalizer line, equalizing any pressure or vacuum between the top of the tank and the top of the gage glass.

To purge (blow out with air) the system of dirt or moisture, depress the knob assembly on the duo-purge valve. This causes the two pistons to assume new positions. This new position causes two things to happen. First, it isolates the top of the gage glass and the top of the liquid well from the rest of the system. Second, low-pressure air at 45 psi is directed through the pressure line and tank downpipe and through the equalizer line to blow out the piping. The purge air entering the tank is vented to atmosphere via the tank vent. Any sludge that may have accumulated around the air bell will be removed by the purging operation.

Compressed Air Model (One-Tube System)

The component parts for the compressed air model (one-tube system) is the same as for the two-tube system except that it has no equalizer line and only one rotometer and one purge valve. A new type vent check valve was incorporated to replace the equalizer line. It was found, after enlarging the JP-5 tank vent piping (over the original black oil system being used), that the atmospheric pressure within the tanks was the same as that over the gage. Therefore, a new type vent check valve was installed on the gage glass which eliminated the need for the equalizer line.

The operation of the one-tube system is the same as for the two-tube system.


PRIMARY RECEIVER
TO 115 V. 50/60 Hz. POWER SUPPLY
SECONDARY RECEIVER (IF REQUIRED)
TANK
TRANSMITTER (HOUSING VOLTAGE DIVIDER)
JUMPER CABLE
FLOAT (MAGNET EQUIPPED)

198.103
Figure 3-14.—Basic components of the Gems TLI system.

NOTE: Because of the nitrogen pressure in the cofferdams surrounding the AvGas tanks, the liquid level indicators in the cofferdams must be a hand pump model.

Gems Tank Level Indicating (TLI) System

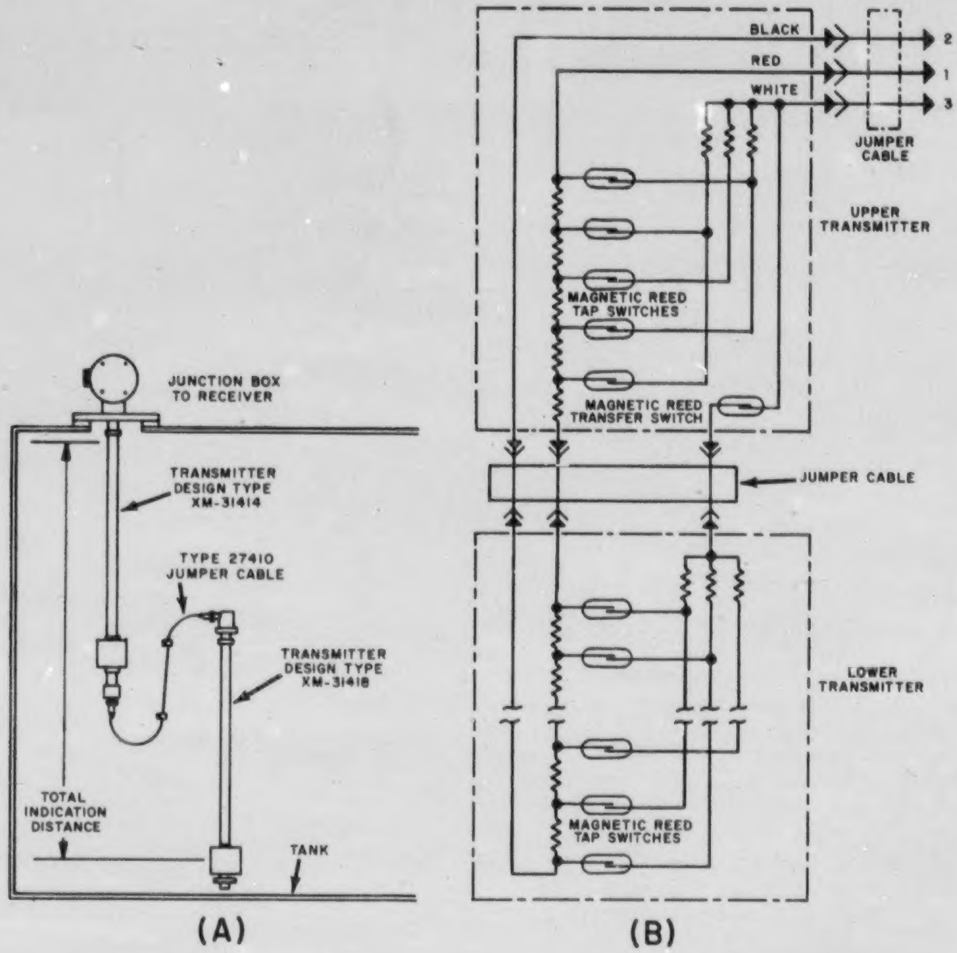
As the three types of liquid level indicators previously mentioned become worn beyond repair, they are being replaced by the Gems tank level indicating system. The Gems TLI system consists essentially of a transmitter, jumper cables, receiver, and a magnet-equipped float. See figure 3-14 for the basic components of the Gems TLI system.

The transmitter is mounted vertically within the tank by means of brackets or flanges. A voltage divider network is located inside and extends the full length of the transmitter assembly. This network is comprised of magnetic reed switches tapped in at one-inch intervals. The switches are connected, in turn, through series resistances, to a common conductor, and by means of the cable system to the indicating meter in the receiver. The ends of the voltage divider are connected to the power supply output, which is adjusted to 10 volts dc by the calibrate potentiometer in the primary receiver.

Depending on the size and shape of the tank being gaged, the transmitter assembly may be a single unit, or a number of units connected together. Figure 3-15(A) shows two transmitters being used to gage a tank. Figure 3-15 (B) is a schematic showing the location of the switches inside the two transmitters.

The magnet-equipped float moves along the transmitter as the liquid level changes. As the float moves, the magnetic field pattern of the float operates the tap switches. The tap switches are so arranged inside the transmitter that voltage drops are read at the receiver for each half-inch of float travel.

The primary receiver is connected to the transmitter by the cable system. Since the receiver meter indicates the voltage drop from the bottom of the voltage divider to the point of tap switch closure, the readings correspond directly with the liquid level. Included in the


JUNCTION BOX
TO RECEIVER
TRANSMITTER
DESIGN TYPE
XM-31414
TYPE 27410
JUMPER CABLE
TRANSMITTER
DESIGN TYPE
XM-31418
TOTAL
INDICATION
DISTANCE
TANK
(A)
BLACK
RED
WHITE
2
1
3
JUMPER
CABLE
UPPER
TRANSMITTER
MAGNETIC REED
TAP SWITCHES
MAGNETIC REED
TRANSFER SWITCH
JUMPER CABLE
LOWER
TRANSMITTER
MAGNETIC REED
TAP SWITCHES
(B)

198.104

Figure 3-15.–Multitransmitter arrangement and schematic.

primary receiver housing, in addition to the indicating meter, are the dc power supply, electrical slosh dampening control, and all system and alarm controls. See figure 3-16 for the various types of primary and secondary receivers.

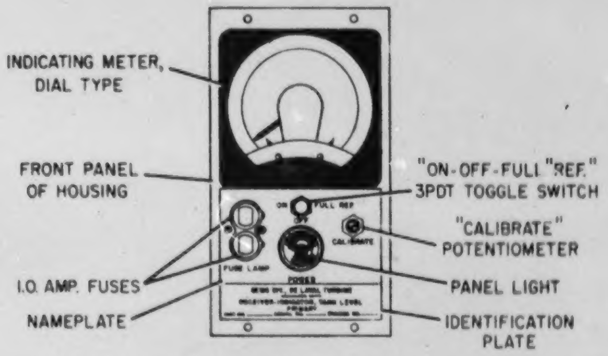
The primary receiver also provides for connection of one or more secondary receivers. The secondary receiver, if utilized, contains an indication meter only.

The system is safe, since currents in the transmitter circuit are so low as to be incapable of causing an explosion, even with the transmitter located in the most volatile liquids or hazardous vapors.

CAUTION: The transmitter or receiver should not be tampered with or modified in any way other than as directed in the operation and maintenance manual.

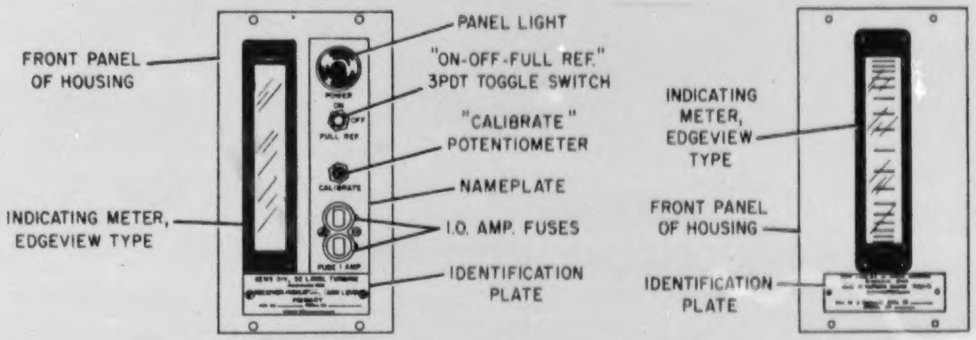
The following is a brief description of the system controls.

ON-OFF-FULL REF. TOGGLE SWITCH–Operates as follows to control the ac


INDICATING METER, DIAL TYPE
FRONT PANEL OF HOUSING
I.O. AMP. FUSES
NAMEPLATE
"ON-OFF-FULL "REF." 3PDT TOGGLE SWITCH
"CALIBRATE" POTENTIOMETER
PANEL LIGHT
IDENTIFICATION PLATE
INDICATING METER, DIAL TYPE
IDENTIFICATION PLATE
FRONT PANEL OF HOUSING

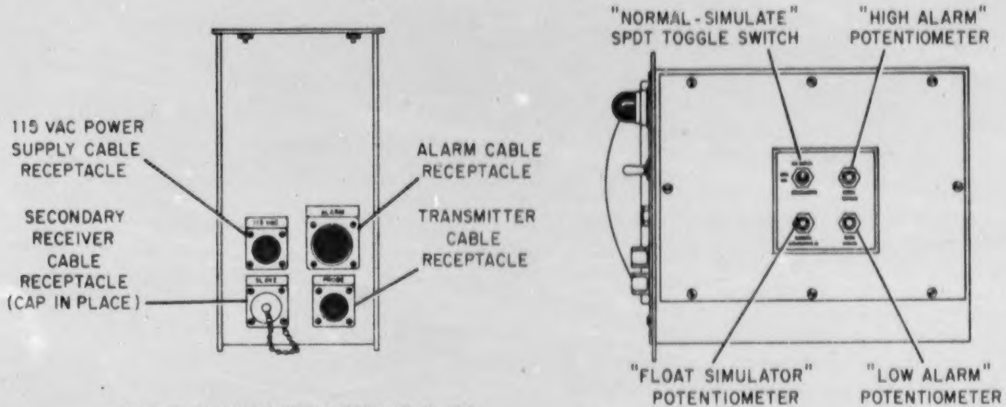
PRIMARY RECEIVER, DESIGN TYPE RE-31320

SECONDARY RECEIVER, DESIGN TYPE RE-31330


FRONT PANEL OF HOUSING
INDICATING METER, EDGEVIEW TYPE
PANEL LIGHT
"ON-OFF-FULL REF." 3PDT TOGGLE SWITCH
"CALIBRATE" POTENTIOMETER
NAMEPLATE
I.O. AMP. FUSES
IDENTIFICATION PLATE
INDICATING METER, EDGEVIEW TYPE
FRONT PANEL OF HOUSING
IDENTIFICATION PLATE

PRIMARY RECEIVER, DESIGN TYPE RE-31360

SECONDARY RECEIVER, DESIGN TYPE RE-31370


115 VAC POWER SUPPLY CABLE RECEPTACLE
SECONDARY RECEIVER CABLE RECEPTACLE (CAP IN PLACE)
ALARM CABLE RECEPTACLE
TRANSMITTER CABLE RECEPTACLE
"NORMAL-SIMULATE" SPDT TOGGLE SWITCH
"HIGH ALARM" POTENTIOMETER
"FLOAT SIMULATOR" POTENTIOMETER
"LOW ALARM" POTENTIOMETER

CABLE CONNECTION RECEPTACLES, BOTTOM OF PRIMARY RECEIVERS

SIDE PANEL (REMOVABLE) OF PRIMARY RECEIVERS

198.105

Figure 3-16.—Primary and secondary receivers.

input to the power supply and the indicating meter circuit:

Toggle in ON position (normal operation)	115 volts, 50/60 Hz applied to the power supply. Indicating voltmeter connected through series resistance to the transmitter tap switches.
Toggle in OFF position	Power supply line and indicating meter circuits are open. System is off.
Toggle in FULL REF. position (must be held in this position)	AC line voltage applied to power supply. Indicating meter is connected across entire transmitter voltage divider and cabling for system calibration.

CALIBRATE POTENTIOMETER – Screwdriver adjusted, with toggle switch held at FULL REF. position, it is adjusted to provide 10 volts dc across the entire transmitter, voltage divider, and cabling, as indicated by a full-scale meter reading. With the potentiometer properly adjusted, when the toggle switch is placed in the FULL REF. position, a full-scale meter reading indicates that all cables and electrical connections are good.

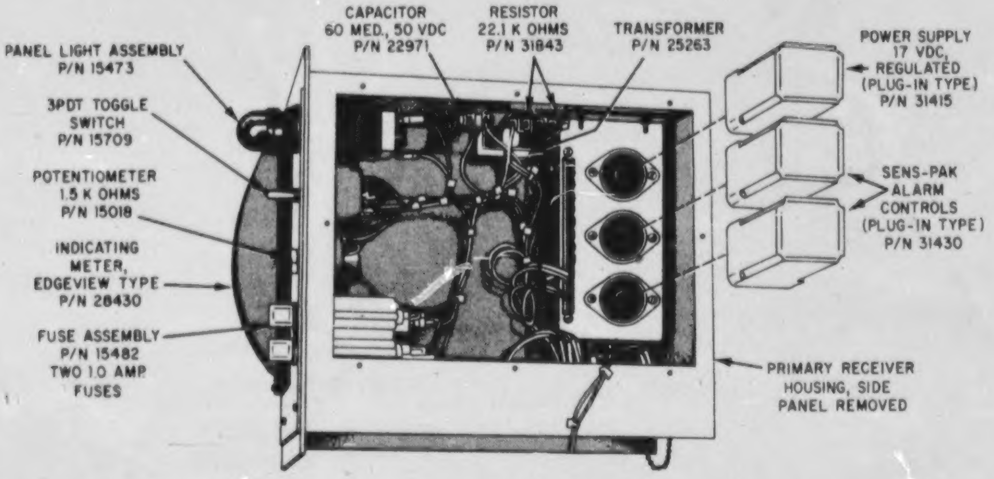
ELECTRICAL SLOSH DAMPENER—To prevent meter fluctuation as a result of erratic float movement caused by sloshing in the tank, a capacitor is connected across the indicating meter to delay response of the meter to the transmitter signal.

ALARM CONTROL SYSTEMS—Known as a SENS-PAK alarm, its controls function integrally with the tank level indication system to sense high, low, or intermediate levels of tank liquids (as appropriate) and actuates an alarm. The modular, plug-in SENS-PAK units (fig. 3-17) are actuated by voltage signals from the indicating system transmitter. These units may or may not be included in the primary receivers.

Although all primary receivers are prewired for a maximum of two SENS-PAK units, normally used for high and low level alarms, additional control units may be incorporated in separate housings within the same system on advice from the factory.

SENS-PAK alarm control adjustments are located on the side of the receiver and function as follows: Refer to figure 3-16 (side panel).

Normal simulate switch	Substitutes the float simulator circuit for the transmitter in the indicating meter circuit for alarm adjustment.


CAPACITOR
60 MFD., 50 VDC
P/N 22971
RESISTOR
22.1 K OHMS
P/N 31843
TRANSFORMER
P/N 25263
PANEL LIGHT ASSEMBLY
P/N 15473
3PDT TOGGLE
SWITCH
P/N 15709
POTENTIOMETER
1.5 K OHMS
P/N 15018
INDICATING
METER,
EDGEVIEW TYPE
P/N 28430
FUSE ASSEMBLY
P/N 15482
TWO 1.0 AMP
FUSES
POWER SUPPLY
17 VDC,
REGULATED
(PLUG-IN TYPE)
P/N 31415
SENS-PAK
ALARM
CONTROLS
(PLUG-IN TYPE)
P/N 31430
PRIMARY RECEIVER
HOUSING, SIDE
PANEL REMOVED

198.106

Figure 3-17.—Primary receiver interior.

Float simulator potentiometer	Simulates the total transmitter voltage divider resistance change over the full range of float travel.
High alarm potentiometer	Sets the actuation voltage level of the high alarm SENS PAK.
Low alarm potentiometer	Sets the actuation voltage level of the low alarm SENS PAK.

This system surpasses the ±3% accuracy requirement of military specifications; however, the accuracy will vary depending on the size tank being gaged and the type receiver utilized.

Practically speaking, specific gravity changes in the tank liquid have no effect on a float riding on the surface. For example, a float 4 inches long, with a specific gravity of 0.5, submerges half way in water (specific gravity of 1.0). Should the liquid specific gravity decrease by as much as 20%, the float would merely ride submerged an additional ½ inch. NOTE: The Gems TLI systems are also approved for indicating the interface level of two liquids having different specific gravities.

With the ON-OFF-FULL REF. toggle switch on the primary receiver in the ON position, operation of the system, and alarms if included, is completely automatic. Tank liquid level is read directly from the indicating meter on the primary or secondary receiver as required. No further attention is necessary, as the Gems TLI system can operate indefinitely without any component degradation.

The only maintenance that should be required at any time is an occasional cleaning of the transmitter and float when tanks are opened for inspection and cleaning.

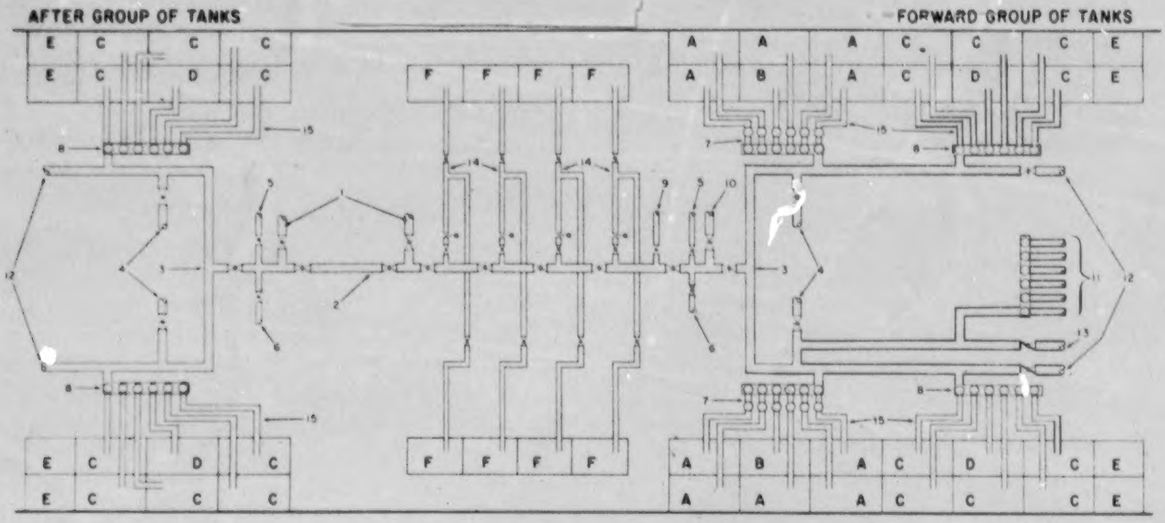
FILLING AND TRANSFER PIPING AND VALVE ARRANGEMENT

The piping and valve arrangements discussed in the following paragraphs include the filling and transfer, stripping, and the service systems. In describing these systems, emphasis is placed on the piping and valve arrangement only and their purposes. Related items, such as pumps, purifiers, filters, etc., are limited to operational functions only, since each is described in more detail in succeeding chapters of this training manual.

In order to operate any JP-5 fueling system safely and efficiently, the ABF must have a thorough knowledge of the arrangement and limitations of the piping systems. Although the piping arrangements are similar for all CVA's, no two ships (not even sister ships) are exactly the same; therefore, you should consult the ship's blueprints for detailed information on your particular ship. The diagrams shown in this chapter are typical arrangements based on information gained from various class carriers, both small and large, old and new. In describing these systems, piping and valves are given specific names instead of numbers. Valve numbers may vary for each ship, but their relative location in relation to the equipment and purpose for which intended are basically the same.

The filling and transfer system (fig. 3-18) and its interconnecting and cross-connecting piping and valves with other systems, serves many functions in the operation of the JP-5 fueling system. It is used primarily for receiving JP-5 aboard when filling the stowage tanks, transferring JP-5 from stowage to service tanks, transferring JP-5 internally from port to starboard (or vice versa) and from forward to aft (or vice versa) when required to correct the list or trim of the ship, and filling the amidship emergency tanks when JP-5 is required for boiler fuel. In addition to the above, the filling and transfer piping is also used to receive and direct JP-5 from the forward independent defueling main into a preselected stowage tank, and from the stripping pump discharge header when consolidating the fuel load (removing the last 24 inches of usable fuel from stowage tanks). The diesel oil day ready service tank can be supplied from a connection off the transfer main. Off-loading of JP-5 is accomplished by the service pumps through cross-connecting piping to the filling and transfer system.

The transfer system is an integral part of the filling system and both are considered as one system. However, due to the congested piping arrangement, they are described separately. The filling and transfer systems are described



A. JP-5 or ballast.
B. JP-5, ballast, or overflow.
C. JP-5.
D. JP-5 or overflow.
E. JP-5 service.
F. Amidships emergency tank.
1. Downcomers.
2. Transfer main.
3. Transfer main branch headers.
4. Transfer pump suction headers.
5. Transfer pump discharge.
6. Stripping pump discharge.
7. Double-valved manifold.
8. Single-valved manifold.
9. Diesel oil day ready service tank line.
10. Defuel main.
11. Double-bottom tank fill lines.
12. Transfer main branch headers (to other stowage tanks).
13. Transfer main branch header (to peak tanks).
14. Amidships emergency tank fill lines.
15. Stowage tank suction and fill lines.

198.12

Figure 3-18.—JP-5 filling and transfer system (piping diagram).

separately in order to give a clearer understanding of their arrangement.

Filling Piping and Valve Arrangement

The filling system encompasses all piping, valves, and related equipment from the filling connections on the main deck to the fill and suction tailpipe in the stowage tanks.

FILLING CONNECTIONS.—The main deck filling connections provide a means of attaching the refueling hose to the ship by a quick-release method and controlling the quality and quantity of JP-5 being received. They are located aft, on the starboard side of the main deck, outboard of the hangar deck, on fueling sponsons or elevator ramp recesses. The number of filling connections vary, depending on the type and class carrier. Some carriers have additional filling connections on the port side to facilitate refueling from a barge when moored to a pier (starboard side to).

The type fittings installed at the filling connection depend on the type quick-release method used with the refueling hose. At present there are two types—Robb assembly and probe assembly. The Robb assembly is discussed first.

A filling connection equipped with the Robb type quick-release coupling and valve assembly (fig. 3-19) consists of a gate valve, a 90° ell, and the male end of the Robb quick-release coupling.

The 90° ell is flanged on both ends to facilitate bolting the inboard end to the gate valve and the outboard end to a quick-disconnect hose coupling. Ell's vary as to size, depending on the size of the downcomer. For example they may range from 6-inch to 6-inch and 8-inch to 6-inch, etc., but regardless of the size of the inboard end, the outboard end is reduced or enlarged as necessary to a 6-inch size. The ell is equipped to provide a means of attaching the following operating equipment:

1. Sampling connection for determining the quality of the fuel being received.

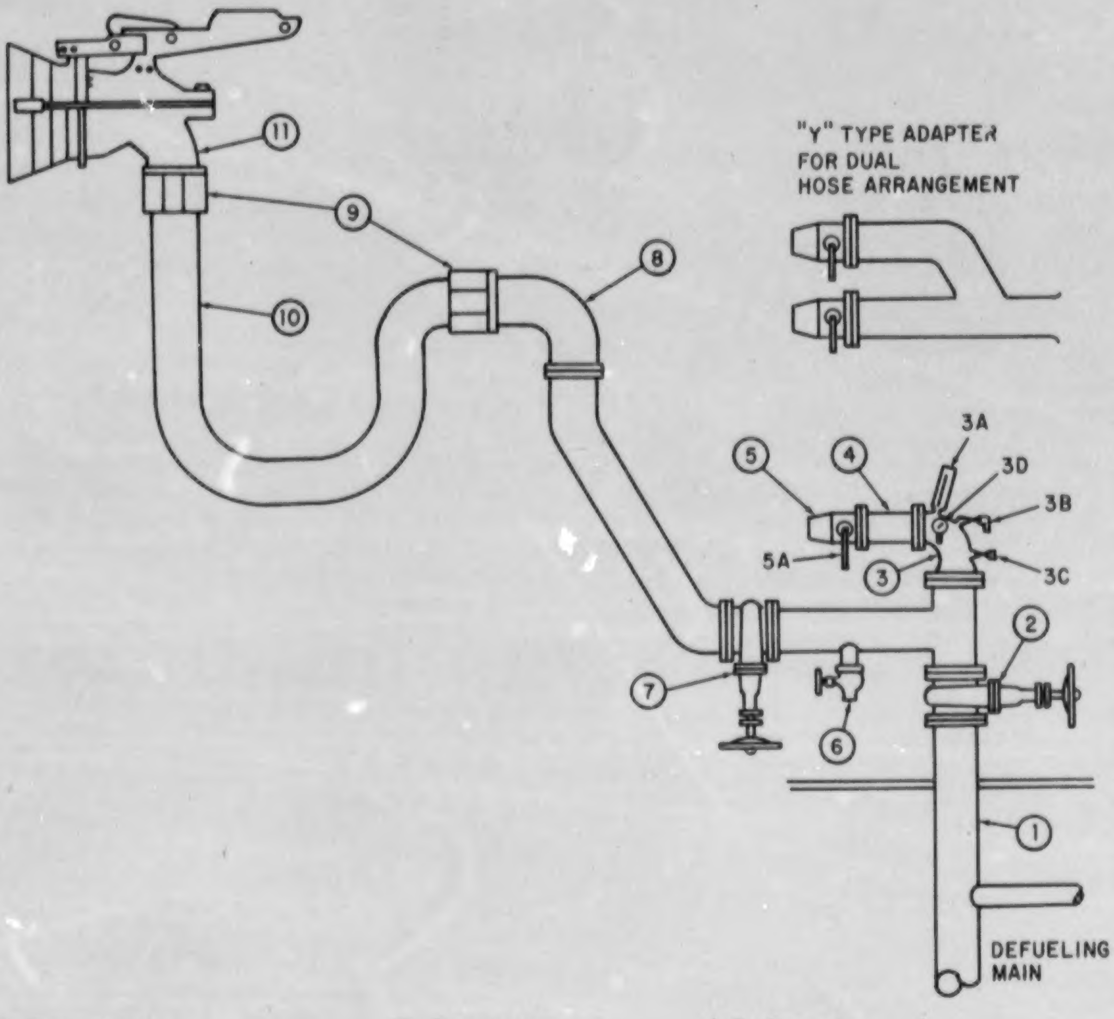
2. Pressure gage to determine the discharge pressure from the refueling source.

3. Thermometer to determine the temperature of the fuel being received.

4. Low-pressure air connection for blowing JP-5 in the hose back to the tanker.

"Y" type adapters are provided on some of the larger carriers to facilitate attaching two refueling hoses to one filling connection.

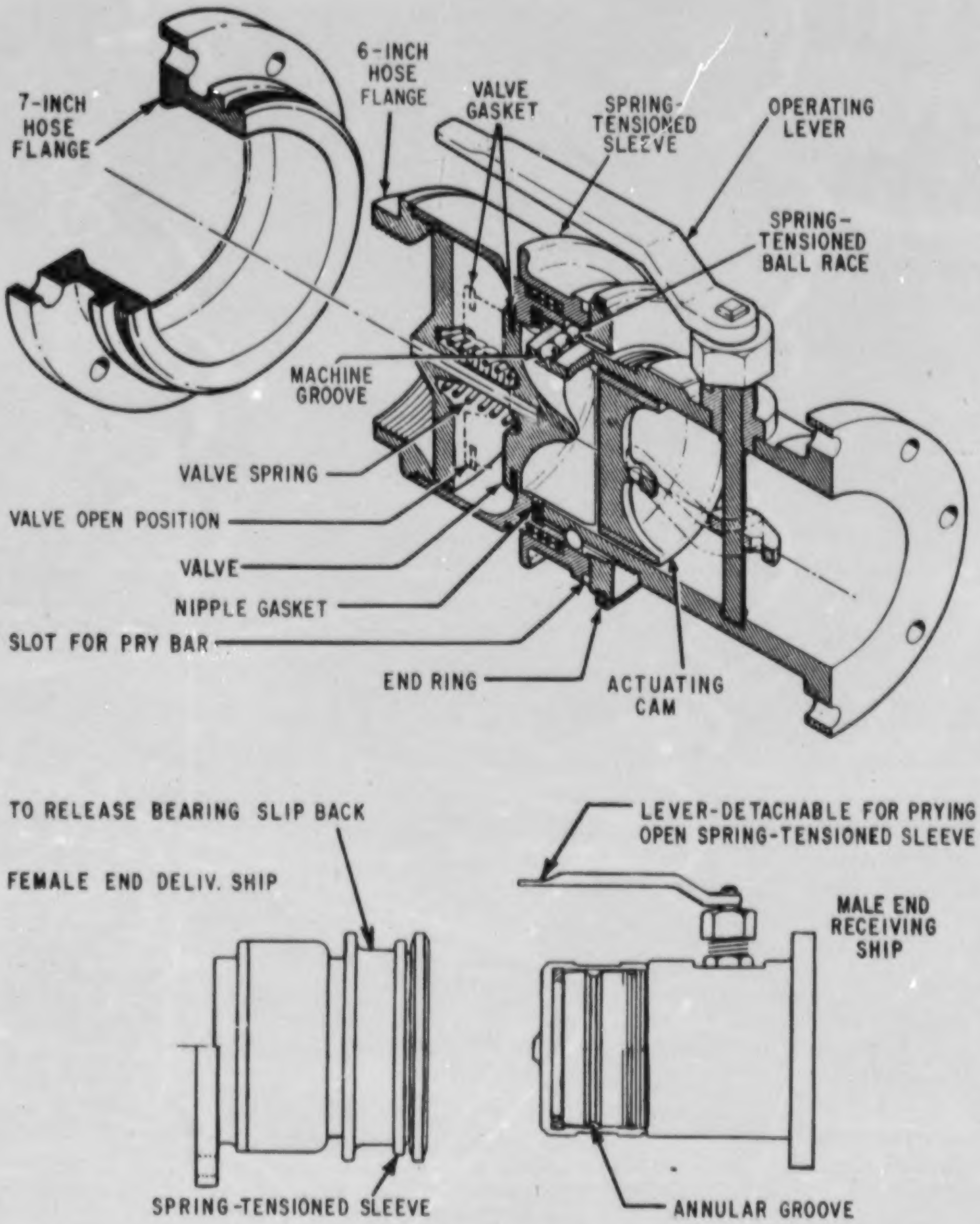
The combined quick-release (Robb) coupling and valve (fig. 3-20) is used for connecting the 6-inch aviation gasoline hose and the 7-inch JP-5 hose from the tanker to one of the ship's aviation fuel filling connections. It permits



1. Downcomer.
2. Gate valve.
3. 8-inch to 6-inch 90° ell.
3A. Thermometer.
3B. Sample connection.
3C. Low-pressure air connection.
3D. Pressure gage.
4. Spool.
5. Male end of 6-inch quick-release coupling.
5A. Valve operating handle.
6. Dump valve.
7. Gate valve.
8. 90° ell.
9. Reattachable coupling.
10. 7-inch rubber hose (wire reinforced).
11. Probe receiver.

198.13

Figure 3-19.—JP-5 main deck filling connection (Robb) and/or probe.


7-INCH HOSE FLANGE
6-INCH HOSE FLANGE
VALVE GASKET
SPRING-TENSIONED SLEEVE
OPERATING LEVER
SPRING-TENSIONED BALL RACE
MACHINE GROOVE
VALVE SPRING
VALVE OPEN POSITION
VALVE
NIPPLE GASKET
SLOT FOR PRY BAR
END RING
ACTUATING CAM
TO RELEASE BEARING SLIP BACK
FEMALE END DELIV. SHIP
LEVER-DETACHABLE FOR PRYING OPEN SPRING-TENSIONED SLEEVE
MALE END RECEIVING SHIP
SPRING-TENSIONED SLEEVE
ANNULAR GROOVE

197.39.1

Figure 3-20.—Combined quick-release (Robb) coupling and valve.

instant disconnection of the fueling hose from the ship if an emergency arises during fueling-at-sea operations.

NOTE: Only the bronze combined quick-release (Robb) coupling and valve is to be used with aviation gasoline and JP-5.

The combined quick-release (Robb) coupling and valve (fig. 3-16) consists of a male and female end. The male half of the combined quick-release (Robb) coupling is attached to the fueling connection aboard the ship to be fueled. This half contains the valve operating lever and bolts directly to the ship's aviation fueling connection spool when the blank flange is removed. The male end is a slightly tapered tube with a standard 6-inch pipe flange at one end, and a groove machined in the outer circumference near the other end. A ring-shaped actuating cam, linked to the valve operating mechanism, is housed within the tube.

The end of the male half of the coupling is protected by a screw cap with a synthetic rubber gasket which must be in place during the time it is not in use or stowed and while it is being handled.

The female half of the combined quick-release coupling is attached to the end of the fueling hose by the supplying ship by means of a flanged hose adapter. The female end contains the spring-loaded valve (normally closed), a spring-tensioned ball bearing race, a spring-loaded sliding sleeve locking assembly, and a sealing gasket. As long as the two ends are separated and/or until the operating lever is placed in the open position, the valve is held closed by the compression spring. A rubber gasket in the valve disc forms a tight seal when compressed against the valve seat. Proper seating of the valve disc is insured by three protruding disc guides.

Before connecting the two halves of the quick-release coupling, examine the gasket in the female half to see if it is properly in place, clean, and not damaged. Examine the end of the male half to see that it is not marred or deformed.

In order to connect the quick-release coupling, both ends must be aligned perfectly. Then proceed as follows: Make sure the operating lever is in the closed position. Slide the sleeve back by hand (toward the hose), compressing the spring. This releases the pressure on the ball race, allowing the ball bearing to retract. Slip the female end over the male end until it bottoms. Proper positioning is determined when the sleeve can be returned to its normal position. This will force the ball bearings into the groove of the male end, locking the coupling in place. With the two ends joined, a tight seal is formed by the male end bottomed against the sealing gasket in the female end. By rotating the operating lever to the open position, the ring-shaped cam (acting on the valve disc guides) is thrust forward, compressing the valve spring and holding the valve in the open position.

All parts of the combined quick-release coupling and valve are interchangeable, regardless of manufacturer.

To disconnect the coupling, it is only necessary to retract the sleeve, releasing the pressure on the ball race. As the female end is withdrawn, the compression spring will automatically close the valve. This procedure is used only in an emergency; normally the valve is closed manually by rotating the operating lever prior to disconnect.

When the two ends are coupled, additional force (other than hand) is usually required to retract the sleeve. For this purpose, slots are cut into the sleeve for the insertion of pry bars between the sleeve and end ring. The bitter-end of the operating lever is formed for this use. Some ships have fabricated large spanner wrenches to give greater leverage for retracting the sleeve. A protective rubber bumper is installed around the end ring to prevent damage to the female end when striking the deck. Although the quick-release couplings are provided in 6-inch size only, both 6-inch and 7-inch hose flanges are available for the female end.

Despite the name, the Robb coupling does not qualify as a quick-release device because uncoupling, difficult ordinarily, is impossible when the fitting is under strain. Even with the riding line taking the strain, both ends must be aligned perfectly for both connecting and disconnecting operations. For this reason, the Robb couplings are being replaced by the probe system.

Because replenishing ships are extremely vulnerable to attack, the Navy constantly strives to improve replenishment equipment and methods in order to speed operations. The time consuming procedure for connecting and disconnecting hose lines prompted efforts to develop means to reduce the time involved in this process. The probe fueling system is a result.

Probe Fueling Rig.–The probe fueling unit, shown in figure 3-21 (A), consists of a fueling probe and a probe receiver. The receiver is supported by a swivel fitting mounted on the receiving ship; a 7-inch diameter rubber hose (wire reinforced) connects the receiver to the filling connection. A pelican hook, used as the attachment point for the span wire, is an integral part of the swivel fitting. The bitter end of the span wire has a special end fitting installed to attach to the pelican hook on the swivel fitting.

The fueling probe is attached to the end of a 7-inch diameter fueling hose and is suspended from the span wire by a trolley. Since the receiver is mounted on the swivel fitting, it is kept directly in line with the span wire and with the probe. This arrangement provides excellent alignment during connect-up of probe and receiver for either the tensioned or non-tensioned span wire.

The fueling probe incorporates a sliding sleeve valve which opens on proper engagement with the probe receiver and automatically closes upon disengagement. A latching mechanism in the probe prevents disengagement during fueling operations. A line pull of 300 pounds on the messenger (remating line) is required to engage the probe in the receiver.

The probe receiver has a lever mounted on the side of the housing to provide a means of disengaging the probe at the receiver. This lever can be installed on either the forward or after side of the receiver to suit local conditions. Visual latch indicators are mounted on each side of the receiver to indicate proper engagement. During probe and receiver engagement, the latch indicators will rise to a vertical position momentarily and return to a position of approximately 30 degrees above horizontal. This indicates that the probe and receiver are engaged, and transfer of fuel can commence. (See fig. 3-17 (B).) Since the fueling probe has a 7-inch I.D. vice the 6-inch I.D. of the Robb coupling, the probe system provides for an improved rate of fuel transfer. The Robb coupling can not be used with the fueling probe.

NOTE: Personnel are required only during connect-up and removal of the span wire and while disengaging the probe from the receiver.

The travel of the probe down the span wire must be controlled at all times to prevent the probe from striking the receiver with undue force. Additional information on refueling may be found in the Replenishment-at-Sea Manual, NWP 38 (Series).

The probe fueling system employs a span wire which is passed in the same manner as for the span-wire rig. After the span wire is connected, the fueling hose, with probe attached, is eased down the span wire until the probe is within a few feet of mating with the receiver. The messenger is then attached to the hook on the trolley, and the probe is hauled in to engage with the receiver. After engagement, the messenger is faked down and made free for running. Riding lines are not required and should not be used with the probe system.

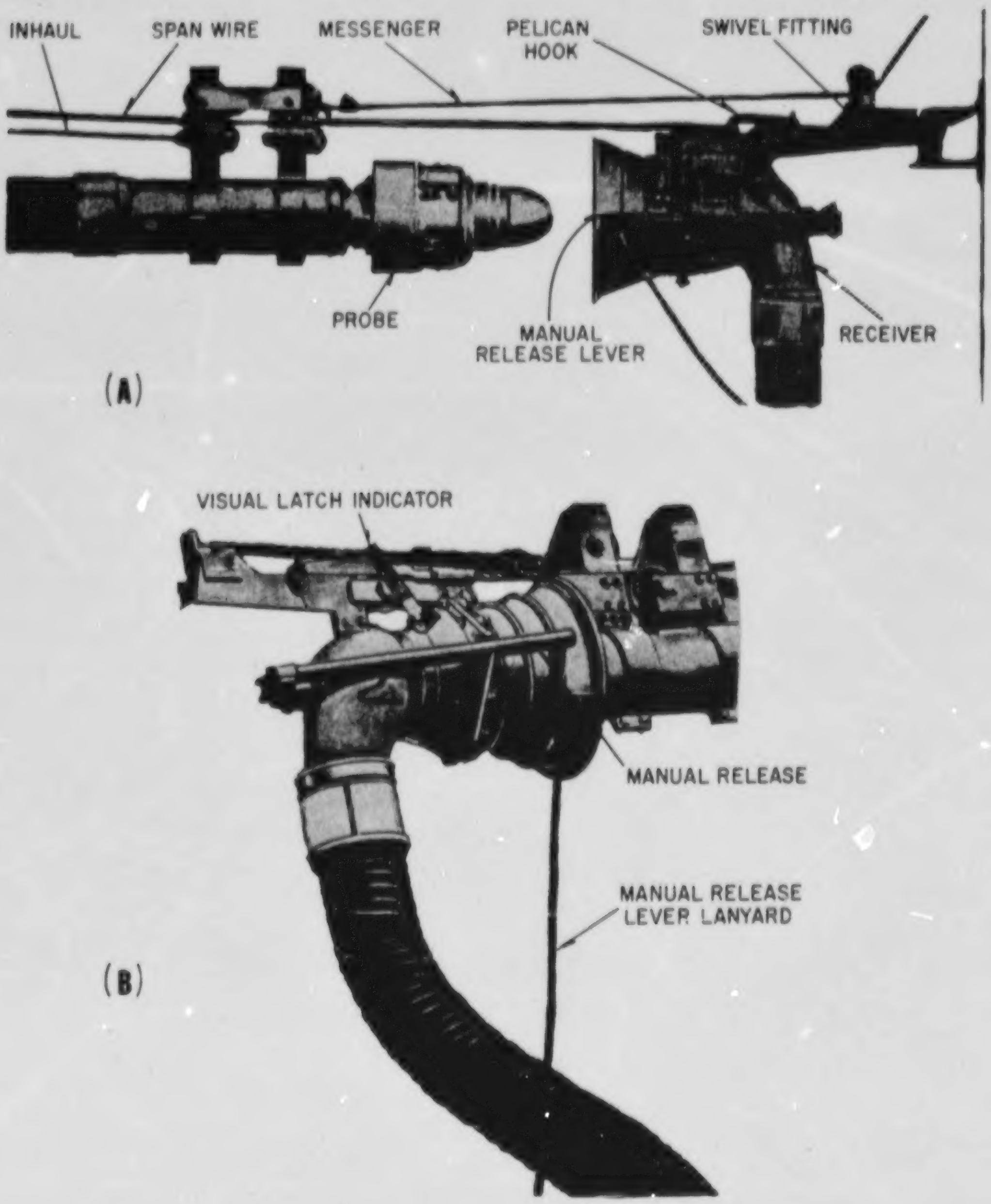
Although it is possible to engage the probe at close distances without a messenger, it is required at ship separations greater than 140 feet due to the catenary (curve) in the span wire.

Blowdown and/or back suction is not required with the probe system after completion of fueling. However, the fuel hose may be cleared if desired. The delivery ship is provided with a special tool for manually opening the probe valve to permit draining of the fuel hose.

After completion of fuel transfer, the manual release lever (fig. 3-21 (B)) is actuated to release the probe, and the delivery ship retrieves the fuel hose. On signal from the delivery ship the pelican hook is then tripped, and the span wire is eased over the side of the receiving ship.

EMERGENCY BREAKAWAY.–If the receiving ship cannot quickly disconnect the probe from the receiver, the delivery ship can do so by taking a strain on the retrieving line saddle whip and/or on the outboard saddle whip (provided a stress wire connects the outboard saddle with the probe trolley). A line pull of 2,500 pounds is required to disengage the probe by this method.

The filling connection gate valve (2, fig. 3-19) is installed between the 90° ell and


INHAUL
SPAN WIRE
MESSENGER
PELICAN HOOK
SWIVEL FITTING
PROBE
MANUAL RELEASE LEVER
RECEIVER
(A)
VISUAL LATCH INDICATOR
MANUAL RELEASE
MANUAL RELEASE LEVER LANYARD
(B)

198.14

Figure 3-21.—Probe fueling unit.

downcomer. This valve is normally the last one to be opened in the system prior to receiving JP-5.

PIPING AND VALVES.—The downcomer is that section of the filling system that connects the filling connection on the main deck with the transfer main on the seventh deck level. There is normally one downcomer for each filling connection installed. The independent defueling main for the service station located in the after part of the ship is attached to one of the downcomers.

NOTE: On newer construction the defuel main is a separate system. It branches from the hangar and flight deck station to the transfer main in the vicinity of the pumproom. An additional gate valve is installed in the downcomer near the bottom where it connects to the transfer main.

NOTE: Periodic inspection is required of valve gaskets (Buna-N-Cork). Flange shields must be provided in accordance with existing instructions when valves are located in machinery spaces (enginerooms, firerooms, etc.).

The Transfer Main runs fore and aft through the bilge just below the seventh deck level. This line interconnects the forward and after group of stowage tanks, the amidship emergency service tanks (on ships so equipped), and the diesel oil day ready service tanks. Besides being connected to the downcomers, it is also connected to the independent defueling main for the forward service stations and the discharge headers of the transfer and stripping pumps.

Gate valves are installed at strategic points throughout the transfer main—at transverse bulkheads (between downcomers), and one at each end. The valves are used to isolate the system during the secured condition and control the flow of JP-5 during the various filling and transfer operations. Each valve has a damage control marking of X-Ray and MUST be closed when not in actual use.

The four amidship emergency service tank supply lines are fitted with gate valves and spectacle flanges. Spectacle flanges are an added safety feature to insure that these lines cannot be opened accidentally. The tanks concerned are fitted with steam coils that must be secured before receiving JP-5. There is one supply line in each of the four main machinery rooms. Each supply line serves two tanks—one port and one starboard.

The diesel oil day ready service tank supply line leading off the transfer main is fitted with a gate valve normally locked closed. The lock is provided to insure proper accountability of JP-5 issued to the engineers. These tanks can be supplied from any JP-5 stowage tank on the ship. Other methods of transferring JP-5 for use as diesel fuel is also provided off the transfer system piping.

The extreme forward and after ends of the transfer main are connected to the transfer main branch headers.

The transfer main branch headers extend outboard from the transfer main and interconnect the stowage tank manifolds with the transfer main. Normally there are only two branch headers for each of the forward and after group of tanks—one port and one starboard; but on ships utilizing double bottom and peak tanks for JP-5 stowage, additional branch headers are required.

Manifolds are an integral part of the JP-5 filling system. They are located between the transfer main branch headers and the stowage tank fill and suction tailpipes. Manifolds consist of a number of valves mounted in a compact unit which provides a means of controlling the flow of JP-5 to and from several stowage tanks from one central location. There are two types of manifolds used in the JP-5 filling system—a double valved manifold and a single valved manifold.

Double-valved manifolds (fig. 3-22) are used to control the flow of JP-5 to and from stowage tanks that are designated stowage or ballast. They give a double protection against contaminating the transfer main when the stowage tanks are filled with sea water; in that sea water must pass through two valves before reaching the transfer main.

The manifold HEADER is a section of 8-inch pipe with several equally spaced 5-inch holes in the top, to accommodate the transfer mainside valves. It is sealed on both ends and has an 8-inch pipe flange welded to the bottom. The

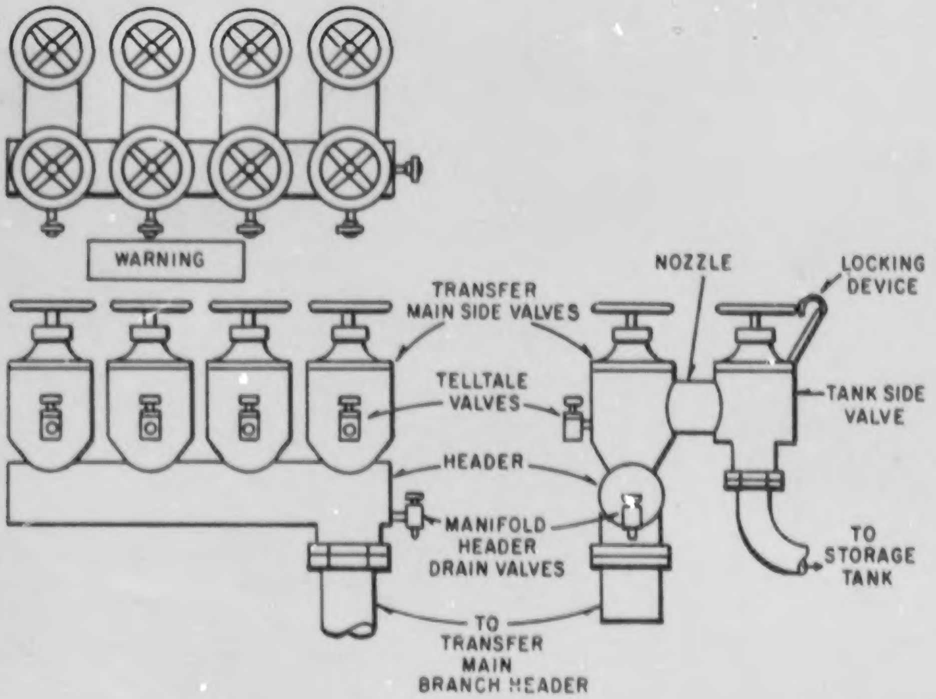

WARNING
NOZZLE
LOCKING DEVICE
TRANSFER MAIN SIDE VALVES
TELLTALE VALVES
TANK SIDE VALVE
HEADER
MANIFOLD HEADER DRAIN VALVES
TO STORAGE TANK
TO TRANSFER MAIN BRANCH HEADER

Figure 3-22.—Double-valved manifold. 198.15

manifold header is bolted to a section of 8-inch pipe leading off the transfer main branch header.

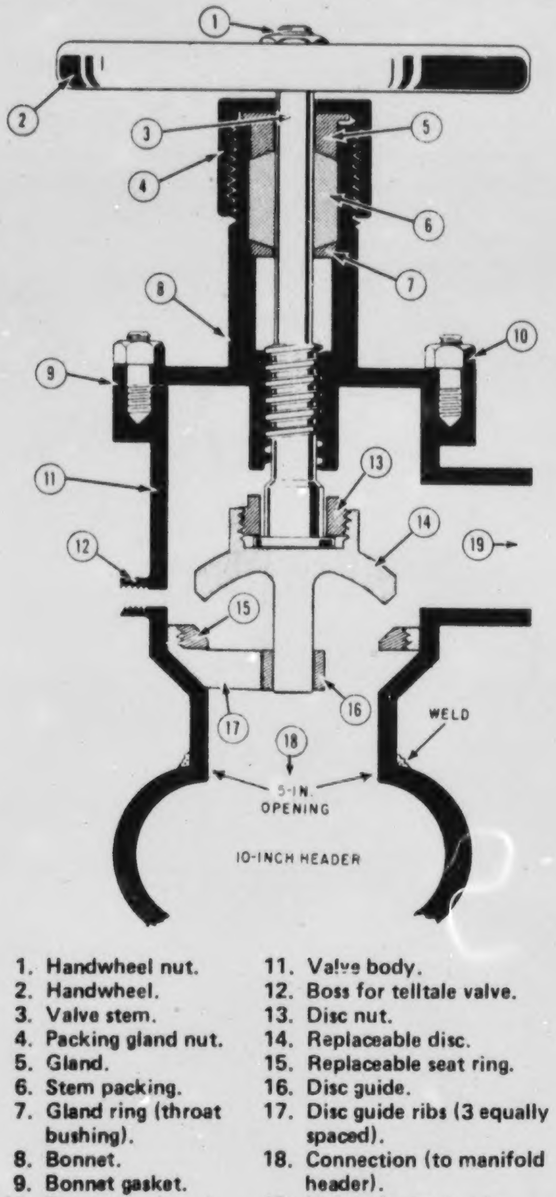
The valves used in the construction of a double-valved manifold are specially designed globe type shutoff valves. These valves are given specific names; i.e., transfer mainside valve and tankside valve. Both valves are practically identical; therefore, only one is described here.

The transfer mainside valves are welded to the top of the manifold header. (See cutaway fig. 3-23.) They are cylindrical in shape (approximately 10 inches in diameter) and consist of a body and a bonnet. The body houses the seat ring and the valve disc. Perfect seating of the valve disc with the seat ring is assured by the disc guide centered in the base of the valve body. The lower section of the valve body, below the seat, is reduced to 5 inches in diameter for welding to the header. A 5-inch hole is machined in the back of the valve body (above the valve seat) for attaching the nozzle. The raised boss on the front of the valve (above the valve seat) is drilled and tapped for installing the telltale valve. The bonnet, which provides a working area for the stem, is bolted to the top of the valve body. Leakage of JP-5 is prevented by a gasket between body and bonnet, and packing in the stuffing box around the stem.

The tankside valve is identical to the transfer mainside valve, except that there is no telltale valve connections and the bottom of the valve body is fitted with a standard pipe flange. (See fig. 3-22.) The stowage tank Fill & Suction tailpipe is bolted to the bottom of this valve.

The nozzle is a short section of 5-inch pipe connecting the two valves in parallel. One end is welded to the side of the transfer mainside valve and the other end to the side of the tankside valve.

The telltale valves are angle type globe valves. There is one telltale valve for each set of manifold valves. These valves are installed on the front side of the transfer mainside valves, above the valve seat. They are used to determine the condition of valve seats. When the stowage tanks are ballasted with sea water, the telltale valves should be opened periodically. If water issues from the telltale valve, it is an indication that the tankside valve is leaking. If JP-5 issues from this valve, it is an indication that the transfer



1. Handwheel nut.
2. Handwheel.
3. Valve stem.
4. Packing gland nut.
5. Gland.
6. Stem packing.
7. Gland ring (throat bushing).
8. Bonnet.
9. Bonnet gasket.
10. Bonnet studs and nuts.
11. Valve body.
12. Boss for telltale valve.
13. Disc nut.
14. Replaceable disc.
15. Replaceable seat ring.
16. Disc guide.
17. Disc guide ribs (3 equally spaced).
18. Connection (to manifold header).
19. Nozzle (to tank side valve).

198.16

Figure 3-23.–Transfer mainside valve (cutaway).

mainside valve is leaking. Leaking valves should be repaired at the first opportunity. Both valves have renewable type seat rings and valve discs.

The manifold header drain valve is installed at the bottom near one end of the header. It is used to drain the header prior to maintenance.

A locking device is provided for each of the tankside valves. There are two types presently in use–a bar type and a chain type. These locking devices are so arranged that the valves can only be locked in the closed position. Tankside valves MUST be locked in the closed position when the tanks are ballasted.

A warning plate, located on or near each double-valved manifold states: "WARNING: VALVE MUST BE LOCKED CLOSED WHEN FLOODED WITH SEA WATER."

Single-valved manifolds (fig. 3-24) are used to control flow of JP-5 to and from stowage tanks designated either JP-5 or JP-5 and overflow. These tanks are not ballasted.

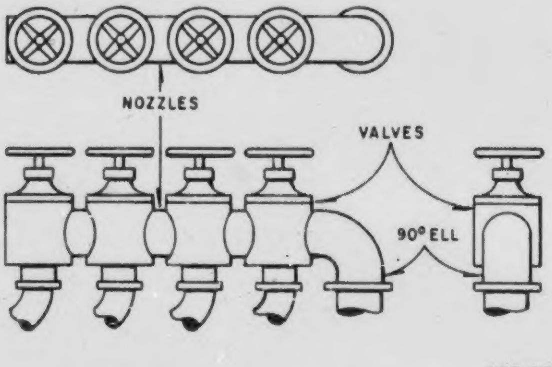
The valves used to construct a single-valve manifold are identical to tankside valves on the double-valve manifold, except for the number and size holes in the side of the valve body. These valves have 8-inch holes in each side (except the last valve) joined together by 8-inch nozzles. A 90° ell flanged on one end is used to bolt the single-valved manifold to the transfer main branch header.

All manifold valves also have a damage control marking of X-Ray and MUST be closed when not in actual use.

Transfer System

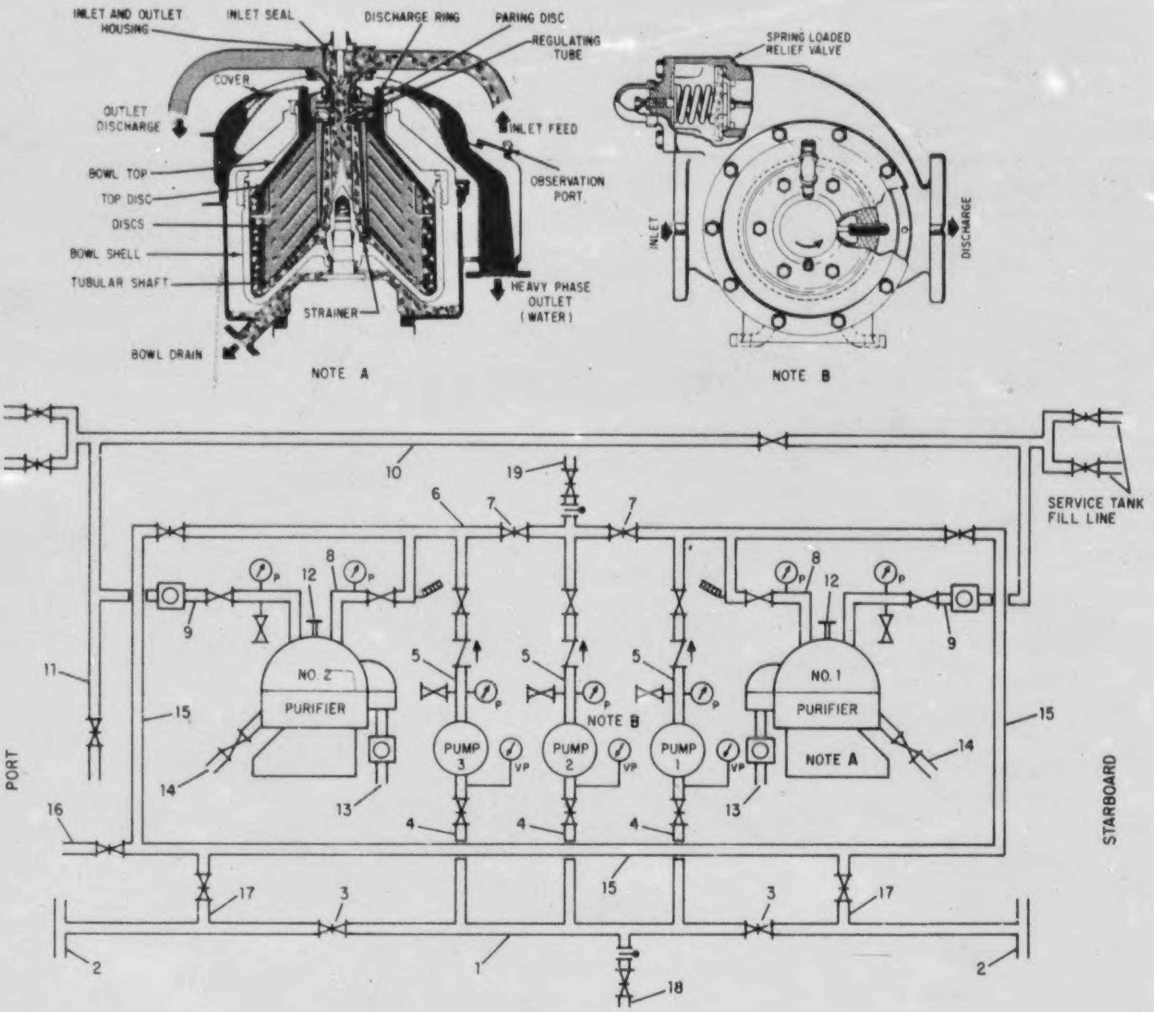
The transfer system discussed here is a typical arrangement utilizing three transfer pumps and two centrifugal purifiers as the filtering equipment. (See fig. 3-25.)

The suction header, which is common to all three transfer pumps, is connected directly to the port and starboard transfer main branch



198.17

Figure 3-24.–Single-valved manifold.


INLET AND OUTLET HOUSING
INLET SEAL
DISCHARGE RING
PARING DISC
REGULATING TUBE
COVER
OUTLET DISCHARGE
INLET FEED
BOWL TOP
TOP DISC
OBSERVATION PORT
DISCS
BOWL SHELL
TUBULAR SHAFT
STRAINER
HEAVY PHASE OUTLET (WATER)
BOWL DRAIN
NOTE A
SPRING LOADED RELIEF VALVE
INLET
DISCHARGE
NOTE B
SERVICE TANK FILL LINE
PORT
STARBOARD
NO. 2 PURIFIER
NO. 1 PURIFIER
NOTE A
NOTE B
PUMP 3
PUMP 2
PUMP 1
P
VP
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19

1. Suction header.
2. Main branch headers.
3. Suction header control valves.
4. Pump inlet.
5. Pump discharge.
6. Discharge header.
7. Discharge header control valves.
8. Purifier inlet.
9. Purifier discharge.
10. Service tank fill line header.
11. Diesel oil ready service line.
12. Seal water inlet.
13. Purifier water discharge.
14. Purifier casing drain.
15. Purifier bypass.
16. Transfer main connection.
17. Suction header crossover to bypass.
18. Cross-connection to service pump suction header.
19. Cross-connection to service pump discharge header.

198.18

Figure 3-25.—Typical transfer system and piping arrangement.

headers. The two gate valves installed in the suction header, one port and one starboard, permit the transfer pumps to take suction from either the port or starboard stowage tanks independently or from both simultaneously.

Three pump inlet lines connect the common suction header with the suction side of the transfer pumps. Each line contains a gate valve and a compound gage (VP). A compound gage measures both vacuum and pressure.

The transfer pumps used in this system are the Blackmer positive displacement, rotary vane type. Each pump has a rated capacity of 200 gpm at 50 psi with a suction lift of 8 inches Hg.

Damage to the positive displacement pump and its associated equipment, due to a buildup of excessive pressure, is prevented by an integral spring-loaded relief valve.

When the pump discharge pressure exceeds the spring setting (normally 50 psi), the valve opens and directs the JP-5 from the discharge port, through an internal passage, back to the suction compartment. Each pump is provided with a manual START-STOP push-button control. In addition, the pump motor is protected by low voltage and overload trips. If the motor is stopped due to low voltage, it may be restarted by pressing the START button. If the motor trips out due to overload, it may be restarted by pressing the RESET-EMERGENCY RUN button and then the START button. During normal operations, when transferring from stowage to service tanks, only two of the three pumps are utilized; one for each purifier.

(CAUTION: Never align the discharge from more than one transfer pump to only one centrifugal purifier. Purifiers have a maximum capacity of 200 gpm.) The other pump is always designated as a standby. The standby duty should be rotated among the three pumps to insure even distribution of service.

The transfer pumps discharge into a common discharge header. Each pump discharge line contains a test connection, pressure gage (P), one-way check valve and a globe type shutoff valve.

The two gate valves are so arranged in the discharge header (one between each pump discharge line) to enable both purifiers to be in operation simultaneously, utilizing any two of the three transfer pumps. For instance, when pump No. 1 is aligned with purifier No. 1, either pump 2 or 3 can be aligned with purifier No. 2. When pump No. 3 is aligned with purifier No. 2, either pump 1 or 2 can be aligned with purifier No. 1. Never align more than one transfer pump to only one purifier.

This valve arrangement also permits two separate transfer operations to be performed simultaneously. For example, when pump and purifier No. 1 are being used to top off a service tank, pumps 2 and 3 can be used to transfer JP-5 from forward to aft, filling amidship emergency service tanks, etc. The same applies for pumps 1 and 2 when pump 3 is being used with purifier No. 2.

CENTRIFUGAL PURIFIER.–The USS CORAL SEA (CVA-43) was one of the first ships to get the centrifugal purifiers. After many months of evaluation, and its proven efficiency over the first stage filters, the purifiers have replaced transfer filters on CVA's and other ships handling large quantities of JP-5.

Purifiers have a rated capacity of 200 gpm when purifying JP-5 between the temperature of 60 °F and 90° F (fuel temperature). When the purifier is in operation, maintain the inlet (feed) pressure at 9 psi and a back pressure on the discharge between 25 psi and 35 psi, with ideal back pressure being 30 psi. The purifier is driven by an electric motor equipped with a remote control START-STOP pushbutton. The arrangement of associated piping is shown in figure 3-21.

The purifier inlet (feed) line, extending off the common discharge header, contains a thermometer, pressure gage, and a globe type shutoff valve. The globe valve is used to throttle the transfer pump discharge pressure entering the purifier to 9 psi. The purifier discharge line contains a pressure gage, test connection, a globe type shutoff valve, and a sight glass gage with flapper. The globe type shutoff valve is used in this line to throttle the JP-5 leaving the purifier to maintain a back pressure of 30 psi. The sight-flow gage and flapper provides a visual and audible check of the fuel being discharged. The discharge line terminates in a common service tank fill line header, from here, it can be directed into any of the service tanks in the forward group.

NOTE: The diesel oil day ready service tank can be supplied via a line off the purifier discharge line to the service tank fill line.

A seal water inlet connection, located between the JP-5 inlet and discharge tubes, directs fresh water into the bowl for use as a seal. A ¾-inch plug valve and flexible rubber hose connects the seal water inlet to the fresh water supply in the pumproom. The purifier is provided with a water discharge line and a bowl casing drain line, both lines terminate in a vapor-free box located below the deck in the pumproom. The water discharge line, which contains the sight-flow gage and flapper, directs any water separated from the JP-5 into the vapor-free box. The bowl casing drain line drains any liquid that may enter the annular space between the revolving bowl shell assembly and the stationary bowl casing. A "locked-open" globe valve is installed in this line.

Due to the vibration created by the purifier during the START-STOP cycle, all lines leading to and from the purifier are equipped with a flexible coupling.

The purifiers are bypassed for all transfer operation except when filling the service tanks. The bypass lines extend off the extreme ends of the transfer pump discharge header and are connected to the transfer main. Control (gate) valves separate the bypass lines from the discharge header. Two valved crossovers, (one port, and one starboard) interconnect the bypass line with the common suction header of the transfer pump. The crossovers are used to align the transfer system for pumping JP-5 from port to starboard or vice versa. The purifier bypass line is also used when transferring JP-5 from forward to aft, filling the amidship emergency service tanks (on ships so equipped), and when off-loading JP-5.

The common suction and discharge headers of the transfer pumps are interconnected with the suction and discharge headers of the service pumps. This arrangement enables the service pumps to be used as transfer pumps (normally for off-loading JP-5). Due to the insufficient static head lift and the low capacity of the transfer pumps, they are not feasible for transferring JP-5 off the ship. The cross-connections between the respective suction and discharge headers are fitted with spectacle flanges (blank side in) and a gate valve (normally locked closed).

STRIPPING SYSTEM

There are two independent stripping systems in each JP-5 pumproom. One system utilizes motor-driven pumps and is interconnected with all JP-5 tanks (both stowage and service) in each group. The other system utilizes hand-operated pumps and is associated with service tanks only. The systems described here are for one pumproom serving one group of tanks. Since each system operates independently of the other, they are described separately.

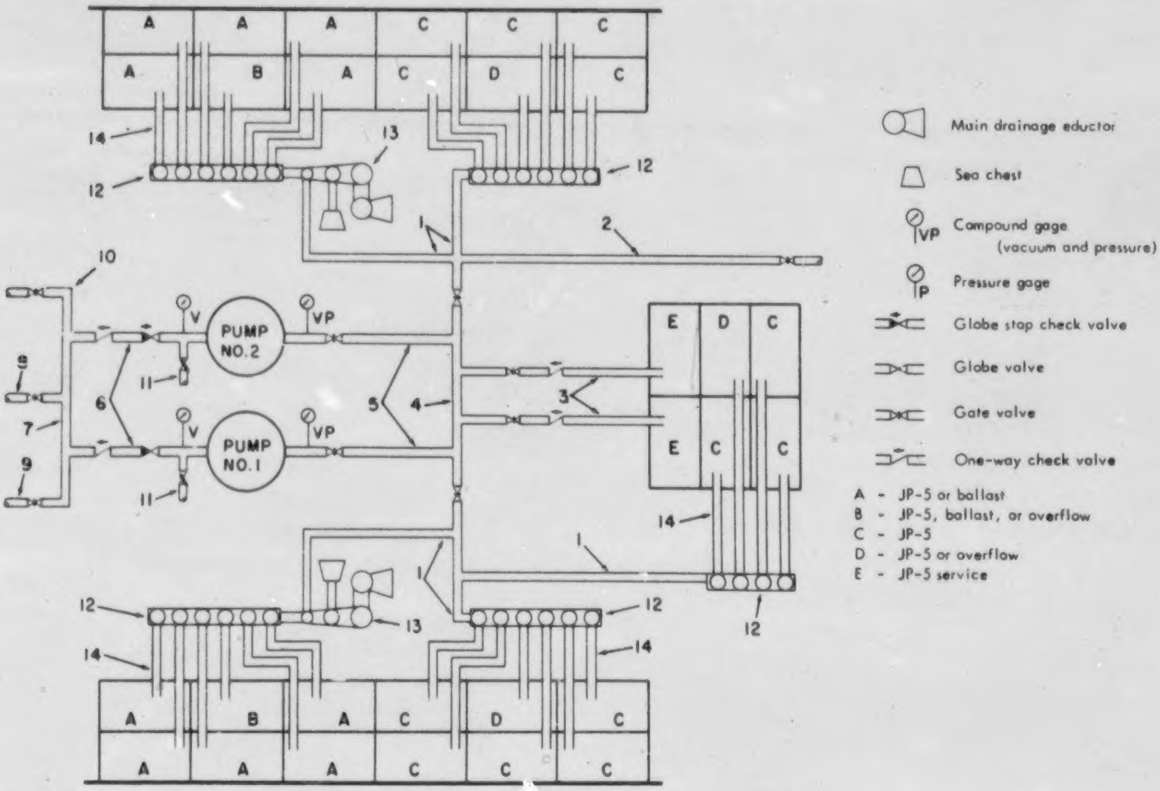
The motor-driven stripping system (fig. 3-26) consists basically of two low capacity pumps, manifolds, and associated piping and valves and is designed to perform the following functions:

1. Remove water and solids from the bottom of the JP-5 stowage tanks (during normal scheduled stripping operations).
2. Remove the last 24 inches of usable fuel remaining in the stowage tanks after the transfer pumps lose suction (when consolidating the fuel load and prior to ballasting the stowage tanks).
3. Remove the remaining sea water left in the stowage tanks by the main drainage eductors (after a deballasting or tank cleaning operation).
4. Remove the remaining 24 inches of JP-5 from the service tanks (prior to cleaning, emptying, etc.).
5. Remove the wash water from the JP-5 service tanks (after a cleaning operation).
6. Remove collected water from transfer filter and centrifugal purifier vapor-free box.

There are two types of manifolds installed in the JP-5 stripping system. One is a single-valved stripping manifold, used with all JP-5 stowage tanks, and the other is a flood and drain manifold which is installed only in the piping to those JP-5 stowage tanks that are designated to be ballasted. The single-valve stripping manifolds (12, fig. 3-26) are identical to the single-valved manifolds described in the filling and transfer system, except that they are physically smaller in size. There is one for each nest of stowage tanks. They are located in the pumprooms or manifold spaces and control the flow of liquids directly to and from the stowage tanks during the various stripping, ballasting, or deballasting operations. The stowage tank stripping tailpipe extends from 1½ inches off the bottom of the tank to the single-valved stripping manifold.

The flood and drain manifolds are located in the stripping system between the single-valved stripping manifolds (for all tanks designated to be ballasted) and the stripping pumps. They are designed to direct the flow of liquids to and from the JP-5 stowage tanks during the following operations from one central location:

1. When ballasting tanks, they direct the flow of sea water from a sea chest supply riser to the single-valved stripping manifold.
2. When deballasting, they direct the flow of ballast water from the single-valved stripping manifold to the main drainage eductor.


A
A
A
C
C
C
A
B
A
C
D
C
14
12
13
12
1
2
10
PUMP NO.2
PUMP NO.1
V
VP
V
VP
8
6
5
4
3
7
9
11
11
E
D
C
E
C
C
14
1
12
13
12
14
12
14
A
B
A
C
D
C
A
A
A
C
C
C
Main drainage eductor
Sea chest
VP Compound gage (vacuum and pressure)
P Pressure gage
Globe stop check valve
Globe valve
Gate valve
One-way check valve
A - JP-5 or ballast
B - JP-5, ballast, or overflow
C - JP-5
D - JP-5 or overflow
E - JP-5 service

1. Stripping suction main (stowage tanks).
2. Stripping suction main (stowage tanks) to other tank nests.
3. Stripping tailpipe (service tanks).
4. Stripping pump suction header.
5. Stripping pump inlet line.
6. Stripping pump discharge line.
7. Stripping pump discharge header.
8. Stripping pump discharge to transfer main.
9. Stripping pump discharge to contaminated oil tank drain system.
10. JP-5 settling tank.
11. Test connection.
12. Single valved manifold.
13. Flood and drain manifold.
14. Stowage tank stripping tailpipes.

198.19

Figure 3-26.—Motor-driven stripping system.

3. When stripping the tanks, they direct the stripped liquids from the single-valved stripping manifold to the suction side of the stripping pumps.

The stripping mains interconnect all the stowage tanks in the group with the common suction header of the stripping pumps. There are normally two stripping mains, one port and one starboard. On ships that are equipped with deep centerlines, double-bottoms, and peak tanks, additional lines are required to facilitate stripping these tanks.

The service tank stripping tailpipes extend a maximum of 1½ inches off the tank bottom and are connected directly to the suction header of the motor-driven stripping pumps. These lines are fitted with a gate valve and a one-way check valve.

The stripping pumps used in this system are the positive displacement rotary vane type. Although smaller in size, they are identical to the pumps described in the transfer system, except for rotor slots and number of vanes. Each pump has a rated capacity of 50 gpm at 50 psi. The pump piping is arranged to take suction from the common suction header (fig. 3-26) and discharge into the common discharge header. The two gate valves in the suction header permit both pumps to take suction from either the port or starboard tanks independently or from both sides simultaneously. The pump inlet piping contains a gate valve and a compound gage. The discharge piping contains a valved test connection, pressure gage, a globe stop check valve, and a one-way check valve. From the discharge header the stripped liquids are directed as follows:

Through the stripping pump discharge to the transfer main when consolidating the fuel load, through the stripping pump discharge to the contaminated JP-5 settling tanks (on ships so equipped) or to the fuel oil tank drainage system. The latter is the property of the engineering department and prior permission and assistance must be obtained before using this system.

Flood and Drain Manifold

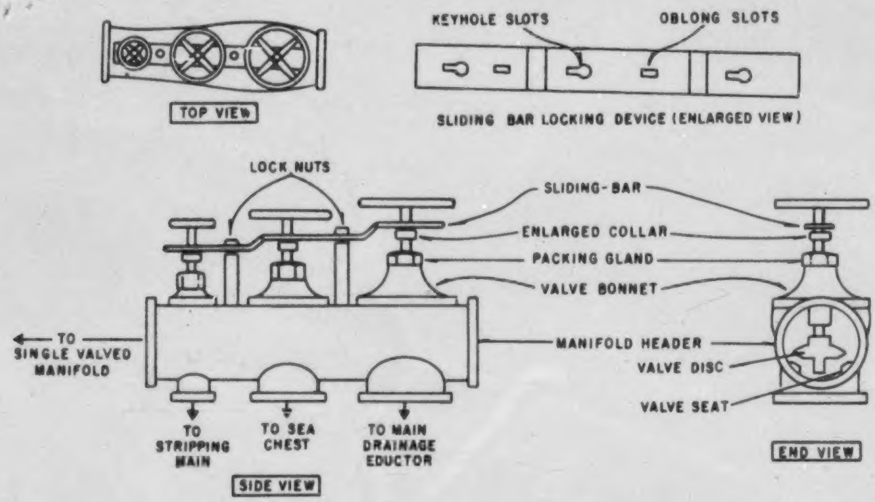
A flood and drain manifold (as shown in fig. 3-27) consists of a manifold header and three globe type shutoff valves.

The manifold header is a common valve body for all three valves. It contains three valve seats and forms an unrestricted passage between the three valves above the valve seats. One end of the header is bolted to the single-valved stripping manifold. The other end is sealed. The upper part of the header houses the valve bonnet, which provides a working area for the valve stem. A gasket is installed between the bonnet and header. A packing gland assembly in the valve bonnet prevents leakage of liquids from around the stem. The lower part of the header, below the valve seats, has three flanged pipe connections, one for each of the three valves.

The stripping line installed just below the stripping valve seat interconnects the flood and drain manifold with the stripping main. This line is used only to direct stripped liquids from the bottom of the JP-5 stowage tanks via the single-valved stripping manifold to the suction side of the stripping pumps. The center line, installed just below the seat of the sea chest cutout valve, interconnects the manifold to a sea chest supply riser. It is used only to direct sea water from the sea chest to the stowage tanks when ballasting.

The other line, installed just below the seat of the main drainage eductor valve, interconnects the manifold to the suction side of a main drainage eductor. This line is used only to direct ballast water from the stowage tanks to the main drainage eductor when deballasting tanks.

The flood and drain manifold is equipped with a locking assembly which allows only one valve to be opened at a time; therefore, allowing only one operation to be performed at a time—stripping, ballasting, or deballasting.



198.20

Figure 3-27.—Flood and drain manifold.

Each valve stem has an enlarged collar, which engages a sliding-bar locking assembly. The valves are locked in the closed position. The sliding-bar is a piece of 3-inch metal strap containing three keyholes and two oblong slots. It is held in place by two locknuts on a threaded bracket, extending up from the manifold. In order to open a valve, the enlarged collar on the valve stem must be centered under the circular part of the keyhole slot. The three keyhole slots are so arranged in the metal strap that only one collar can be so positioned at a time. The other two collars will be positioned under the rectangular part of the other two keyhole slots and cannot be opened. To position the bar, loosen the two locknuts and slide the bar through the oblong slots to the desired position and retighten the nuts.

Hand-Operated Stripping System

There are two hand-operated stripping pumps in each JP-5 pumproom. (See fig. 3-28.) Their primary purpose is to remove water and solids from the bottom of the service tanks. However, they are also used on some ships to empty the transfer filter and/or purifier water drain box. These pumps have a rated capacity of 30 gpm at 50 double strokes per minute. The service tank tailpipe which contains a shutoff valve, terminates three-fourths inch off the service tank bottom. The discharge line contains a sight glass gage, test connection, one-way check valve, and a shutoff valve. Liquids removed by the hand-operated stripping pump are discharged directly overboard at the third deck level.

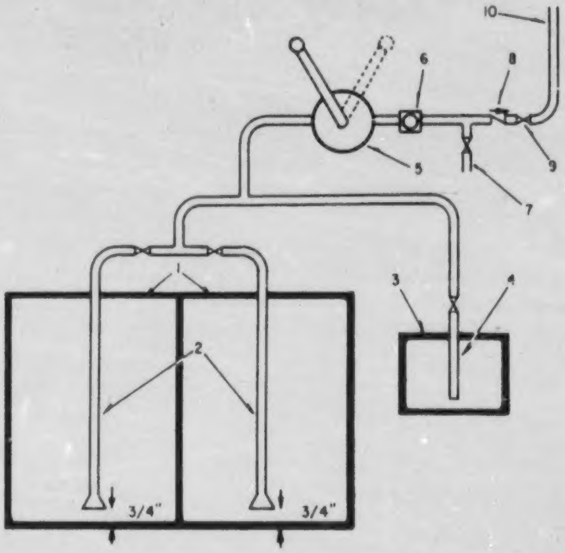
SERVICE SYSTEM PIPING AND VALVES

The service system piping and valves include all the piping, valves, and related equipment necessary to deliver clean, bright, water-free JP-5 from the service tanks (on the eighth deck level) to jet aircraft on the hangar and flight decks.

The arrangement of the service systems, at the pumproom level, is practically identical for all carriers, except for the number of service pumps installed (two or four). These differences, as to the number and capacity of the service pumps in each pumproom for the different type and class ship, were noted earlier in this chapter. The service system piping and related equipment between the pumproom and service stations will vary, depending on the type service station installed (Blackmer or Cla-Val). Both systems are described in this section.

The service system described here is a forward section of a typical CVA system utilizing four service pumps (two per quadrant) servicing both Blackmer and Cla-Val service stations without reference to size or capacity. (See fig. 3-29.) This system was chosen in order to cover the maximum amount of operating equipment an ABF is most likely to encounter in any JP-5 pumproom and on any type ship.

Gate valves or butterfly valves are installed throughout the service system piping at the pumproom level, except for the service pump



1. Service tanks.
2. Service tank stripping tailpipe.
3. Drain tank (for 1st-stage filters or centrifugal purifiers).
4. Drain tank tailpipe.
5. Hand pump (30 gpm at 50 double strokes per minute).
6. Bull's-eye sight glass gage.
7. Test connection.
8. One-way check valve.
9. Shutoff valve.
10. Pump discharge to overboard.

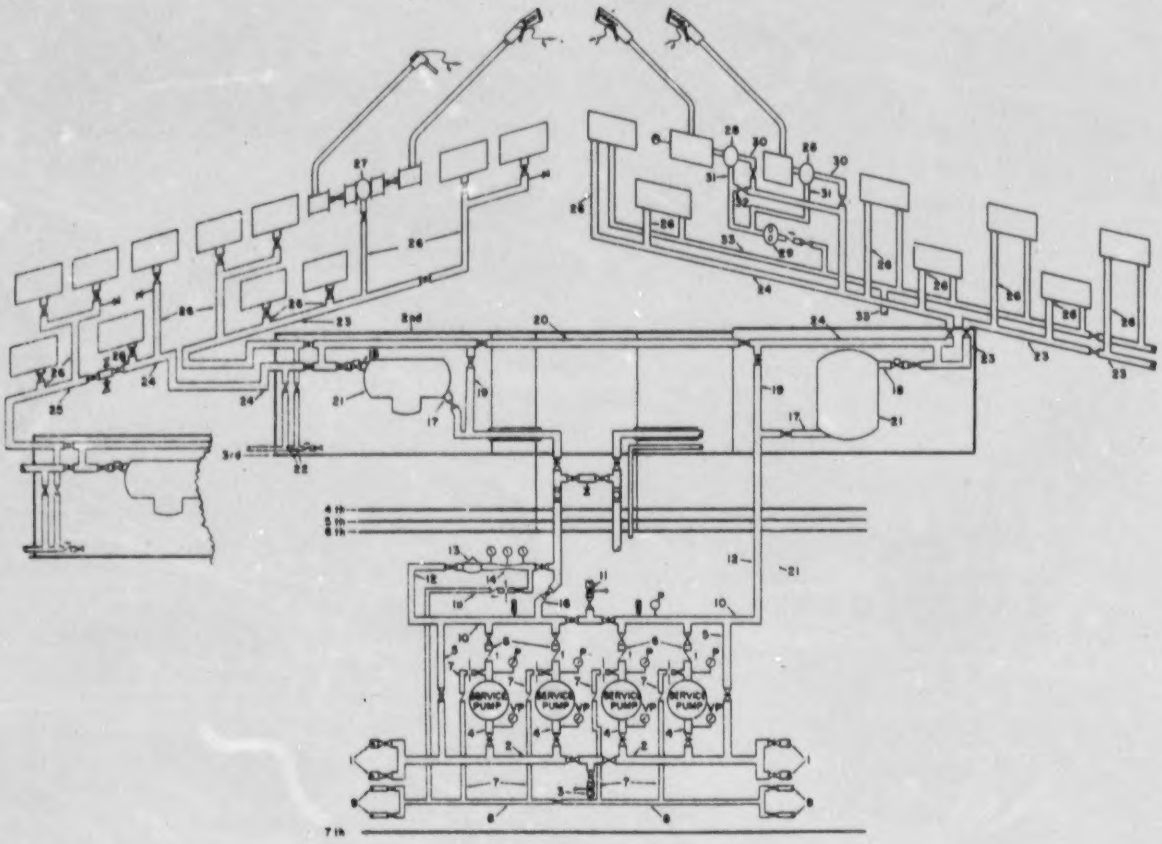
196.21

Figure 3-28.—Hand-operated stripping system.

discharge and recirculating lines, which are globe type shutoff valves. Therefore, in describing the location of the valves, they are referred to generally as shutoff valves without reference to type.

Pumproom Piping Arrangement

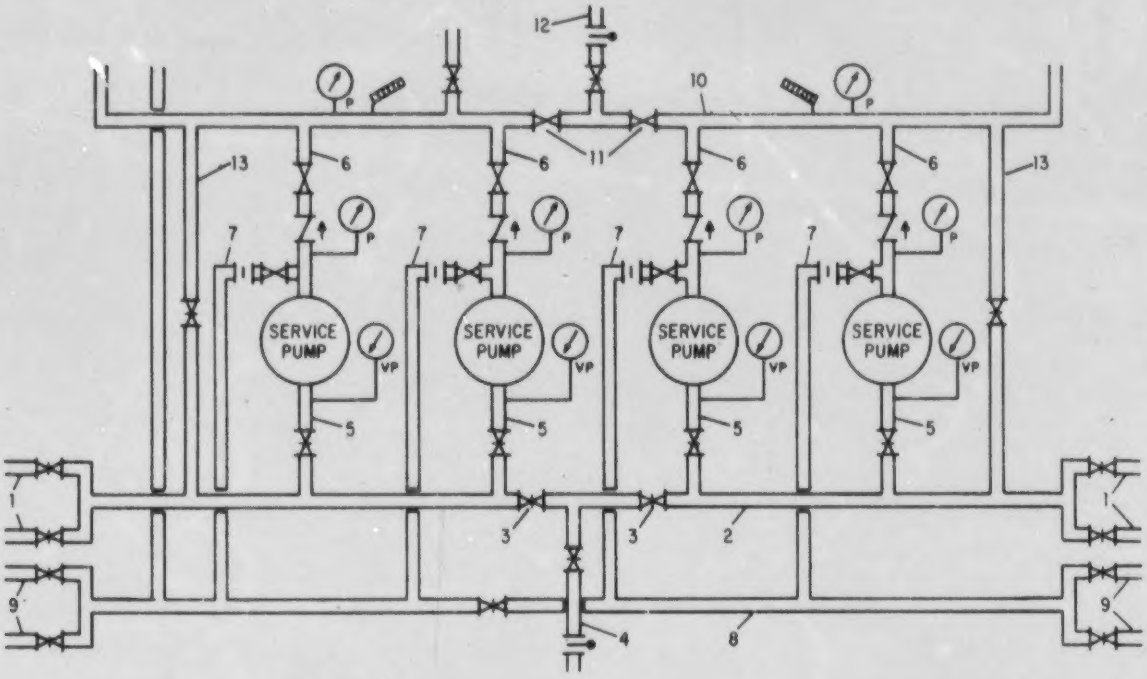
The service system piping in the pumproom (fig. 3-30) commences with the service tank suction tailpipes. These lines extend from 24



1. Service tank suction tailpipe.
2. Service pump common suction header.
3. Cross-connection to transfer pump suction header.
4. Service pump inlet line.
5. Service pump bypass line.
6. Service pump discharge line.
7. Service pump recirculating line.
8. Recirculating header.
9. Service tanks recirculating lines.
10. Service pump common discharge header.
11. Cross-connection to transfer pump discharge header.
12. Quadrant distribution riser.
13. Pressure-regulating valve.
14. Venturi tube.
15. Recirculating line.
16. Pressure regulator bypass line.
17. Filter inlet.
18. Filter discharge.
19. Filter bypass.
20. Filter bypass cross-connection.
21. Filter.
22. Emergency drain line.
23. Forward quadrant distribution main.
24. After quadrant distribution main.
25. Forward leg of after quadrant.
26. Service station risers.
27. Blackmer fueling unit.
28. Cla-Val fueling and defueling valve.
29. Defueling pump.
30. Fueling unit inlet lines.
31. Defuel line.
32. Defuel recirculating line.
33. Defuel main.

198.22

Figure 3-29.—Service system piping and valves.



1. **Service tank suction tailpipes.**
2. **Suction header.**
3. **Suction header crossover valves.**
4. **Cross-connection to transfer pump suction header.**
5. **Pump inlet.**
6. **Pump discharge.**
7. **Service pump recirculating line.**
8. **Recirculating header.**
9. **Service tank recirculating lines.**
10. **Discharge header.**
11. **Discharge header crossover valves.**
12. **Cross-connection to transfer pump discharge header.**
13. **Pump bypass lines.**

198.12

Figure 3-30.—Pumproom piping arrangement.

inches off the tank bottom to the service pump common suction header. Each line is fitted with a shutoff valve to isolate the tank from the system when not in use.

The service pump common suction header is divided into a port and starboard suction header by a set of crossover valves. The cross-connections from the transfer pump suction header, fitted with a shutoff valve and spectacle flange, interconnect with the service pump suction header between these two valves. This arrangement allows two service pumps to be used as transfer pumps and two for servicing aircraft simultaneously and independently of each other. This, of course, would be an emergency arrangement in the event all three transfer pumps were disabled. Otherwise, normally, the cross-connection is opened only to allow service pumps to be used for off-loading JP-5. During normal operations, both crossover valves in the suction header are open to allow the use of any service pump with any service tank.

The service pumps are connected to the suction header by the pump inlet. This line contains a shutoff valve and a compound gage. The discharge line, connecting the pumps to the common discharge header, contains a recirculating line, pressure gage, one-way check valve, and a globe type shutoff valve. The recirculating line is orificed to recirculate approximately 5 percent of the rated capacity of the pump back to the service tank from which suction is being taken. The recirculated fuel through the pump casing keeps the pump cool during standby condition. This would be the case when the system is pressurized (pumps are running) but no fuel is being drawn off topside. The recirculating lines (one for each service pump) terminates in a recirculating header. The header in turn is connected to each service tank recirculating line. These lines, fitted with shutoff valves, terminate 18 inches off the tank bottom. When the system is being placed in operation, the recirculating header MUST be alined to the service tank from which suction is being taken prior to starting the pump.

The service pump discharge header is common to all four service pumps, but like the suction header, it, too, is divided into port and starboard headers by a set of crossover valves. An additional pressure gage and a thermometer are installed in each port and starboard discharge header. The cross-connection to the transfer pump discharge header is used in conjunction with, and for the same purpose as, the cross-connection between the respective suction headers of the transfer and service pumps.

Each set of service pumps is provided with a bypass line. These lines are used to drain the distribution piping back to the service tank and for venting the system during the initial filling operation.

SERVICE PUMPS

The most common service pumps used in the JP-5 system are the centrifugal type. There are two different capacities on CVA's—675 gpm on ships with 6-inch distribution piping and 1,100 gpm on ships with 8-inch piping. The rated discharge pressure of each pump will vary depending on the type service station installed on the individual ship, either Blackmer or Cla-Val. Pumps installed in the service system on LPH's and LPD's have only one capacity (220 gpm) and one discharge pressure (90 psi) since they have only one type service station (Cla-Val).

Table 3-4 lists the different capacities and discharge pressures of the pumps in relation to the type service station installed. Regardless of the rated capacity or discharge pressure, all Allis-Chalmers pumps are identical, except for their physical size.

Each pump is provided with an electrical controller which supplies current to the pump motor. The controllers are actuated by remote pushbutton switches conveniently located in the pumproom. These switches include a START, STOP, EMERGENCY RUN, and RESET pushbutton. Additional safety devices are also provided to automatically deenergize the controllers in the event of a malfunction to the pumps or operating equipment.

The safety devices consist of a pressure-operated switch actuated by pump discharge pressure, a timing switch actuated by timing relays in conjunction with the pressure switch, and overload and low-voltage trip switches. The pressure-operated and timing switch is set to deenergize the controllers if a discharge pressure of 35 psi is not obtained within 3 minutes. In the event the controllers are deenergized by any of the safety devices, they must be RESET before the pump motor can be restarted.

CAUTION: Check the cause of the malfunction first, before pushing the RESET button.

A centrifugal pump will use less power when starting if the discharge valve is closed and when pumping its rated capacity. Therefore, always start the pump with the discharge valve closed until a pressure of 80 psi is obtained, then slowly open the valve to full open position.

CAUTION: Always throttle the flow into the distribution piping to prevent a hydraulic shock in the system.

DISTRIBUTION PIPING AND COMPONENTS

Quadrant Distribution Riser

Two separate arrangements of the quadrant distribution risers are discussed in the following paragraphs. One is for ships having the Blackmer service stations, and the other for ships having the more modern Cla-Val service stations. Although both port and starboard quadrants would be identical on their respective ships, only

Table 3-4.—Pump capacities and discharge pressures

Pump capacity	Discharge pressure	Type service station
675 gpm	75 psi	Blackmer
675 gpm	150 psi	Cla-Val
1,100 gpm	95 psi	Blackmer
1,100 gpm	150 psi	Cla-Val
220 gpm	90 psi	Cla-Val

one of each (Blackmer to port and Cla-Val to starboard) is described herein. (See fig. 3-31.) However, the cross-connecting piping between the two quadrants will be noted where applicable.

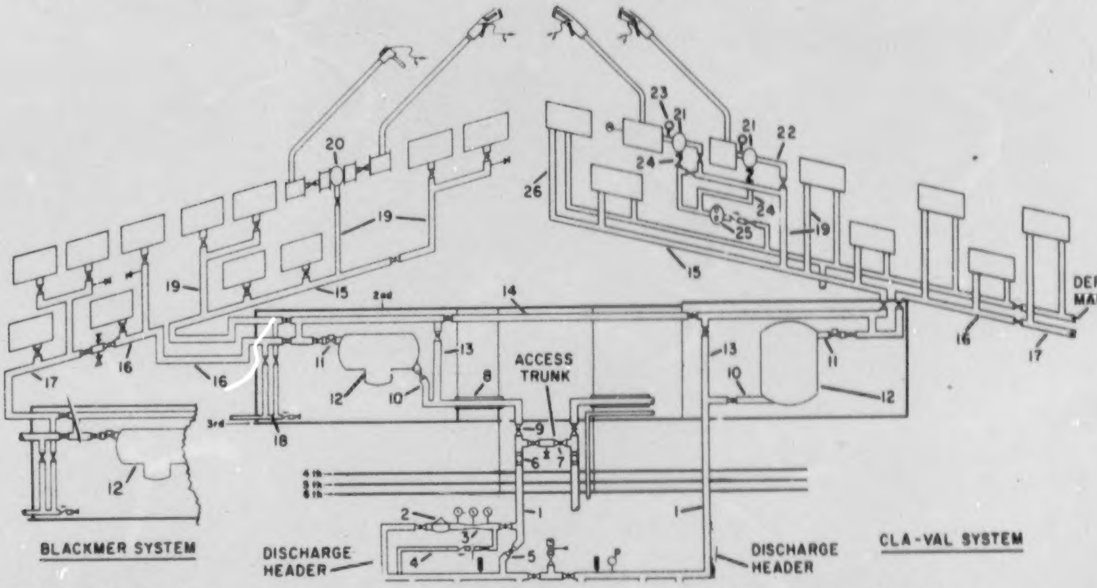
Blackmer Service System Piping

The piping arrangement discussed in the following paragraphs is for the Blackmer Service Station only.

Nonlubricated positive stop valves are installed throughout the quadrant distribution risers, except on test connections, recirculating lines, and drain lines. In describing the location of the valves, they are referred to as shutoff valves without reference to type.

The quadrant distribution riser is that section of the service system piping which connects the service pump discharge header (on the 7th deck level) with the service stations on the hangar and gallery decks.

Blackmer service stations will not function properly if the inlet fuel pressure exceeds 20 psi or drops below 5 psi. For this reason, an automatic pressure-regulating system is installed in each quadrant distribution riser to maintain a constant (predetermined) pressure throughout the quadrant under all conditions of operation or load. The required pressure will vary for each individual ship, depending on the size and length of the distribution riser. The pressure regulator, located at the pumproom level, consists of an automatic pressure-regulating valve actuated through changes of pressure in the throat of a



1. Distribution riser.
2. Pressure-regulating valve.
3. Venturi.
4. Venturi recirculating line.
5. Venturi bypass line.
*6. Flowmeter.
*7. Fourth deck quadrant crossover lines.
*8. Double-walled piping.
9. Fourth deck riser valve.
10. Filter inlet.
11. Filter discharge.
12. Filter.
13. Filter bypass.
14. Filter crossover.
15. Outboard main (fwd leg).
16. Outboard main (after leg).
17. Outboard main (fwd leg of after quad).
18. Emergency drain lines.
19. Service station risers.
20. Blackmer fueling unit.
21. Fuel/defuel valve.
22. Valve inlet line.
23. Valve discharge line.
24. Valve defuel line.
25. Defueling pump.
26. Defuel pump cross-connection to supply riser.
27. Defueling pump discharge line.

* These components are NOT required for JP-5 systems; however, they may exist in modified AvGas systems converted to JP-5 service.

Figure 3-31.—Quadrant distribution risers (Blackmer to port, Cla-Val to starboard). 198.25

venturi which is installed in the downstream side of the valve. This system is entirely hydraulic in operation, utilizing line pressure to open and close the valve. Pilot and control valves are provided in the actuating lines to insure sensitive control and accurate regulation of the required delivery pressure. A recirculating line, located on the downstream side of the venturi, is orificed to recirculate 100 gpm back to the service tank from which suction is being taken. This line, which also contains a one-way check valve and a shutoff valve, terminates in the recirculating header. The recirculated fuel provides a flow through the automatic pressure-regulating system at all times. This flow of fuel allows the main valve to be partially opened, maintaining a constant pressure throughout the system—even during standby conditions (when the system is pressurized and no fuel is being drawn off topside). Shutoff valves are installed in the inlet and discharge line for each pressure regulator. A bypass line fitted with a shutoff valve is installed around the pressure-regulating system. This line is used when initially venting and filling the system with JP-5 and when draining back the system.

NOTE: Operation and maintenance of the automatic pressure regulator is discussed in chapter 9 of this manual.

From the pressure-regulating system, the distribution piping extends upward from the pumproom through the vertical access trunk, where it interconnects with the original AvGas piping at the fourth deck level.

NOTE: All CVA's with Blackmer service stations were converted from the interim system and utilize the original high capacity aviation gasoline system piping and valves from this point on.

There were certain pieces of equipment installed in the original AvGas distribution riser between the fourth deck level and the main fuel filters (on the third deck) that are not necessary in the handling of JP-5; such as, flowmeters, fourth-deck quadrant crossover lines, and double-walled piping. This equipment has either been eliminated or made inoperable; therefore, it is not discussed in this chapter. The shutoff valve installed in the distribution riser just above the fourth deck level is commonly referred to as the fourth-deck riser valve. The riser continues up through the access trunk to just above the third deck where it bends outboard through a transverse trunk to the filter room (near the skin of the ship). Here it connects with the service fuel filter.

FILTER/SEPARATORS.—There are several different types of filter/separators in use in the fleet; however, their principle of operation and hydraulic controls are similar. The only major differences in filters are their physical shape and rated capacity. Some are horizontal and others are vertical. There are two different capacity filters installed in the JP-5 service systems on CVA class carriers. One is a 1,200 gpm on ships with 6-inch distribution piping, and the other is a 2,000 gpm on ships with 8-inch piping. The 1,200 gpm filters are of the horizontal type, but the 2,000 gpm filters may be either horizontal or vertical. All main fuel filters on CVA's (one for each quadrant) are installed in the risers at the third deck level, outboard near the skin of the ship. The LPH-2 and LPD-1 class ships utilize vertical filters only. The LPH's have one 300 gpm filter at each service station, and the LPD's have only one 400 gpm filter located in the distribution piping at the pumproom level.

Regardless of the direction or rate at which fuel passes through the filters, or where they are located in relation to other components in the system, all filters are designed to perform the same function (separate and remove solids and water from the fuel) and in practically the same manner.

Filters are designed to separate and remove from the fuel 98 percent of all solids five microns, or larger, and in excess of 99.9 percent of all entrained water. This is accomplished in a two-stage operation by two separate filtering media installed within the filter shell. The first stage consists of a bank of COALESCING elements which perform the function of removing solids and coalescing water (bringing together fine particles of entrained water to form large droplets) to allow the water to fall out of the fuel by gravity; the second stage consists of a bank of SEPARATOR elements which perform the function of repelling water (removing from the fuel coalesced droplets that were too small to fall out by gravity), and filter out micron particles. The unit is equipped with a hydraulic device that will automatically drain the accumulated water from the filter sump and shut off the filter discharge in the event more water accumulates than can be drained off automatically.

A brief description of the horizontal filter only and its associated piping is discussed here. (See fig. 3-32.) Minor differences in the vertical type are noted in the section to follow on the Cla-Val system. The hydraulic devices for the automatic water drain and fuel shutoff valves are covered in the detailed description of filters in chapter 8.

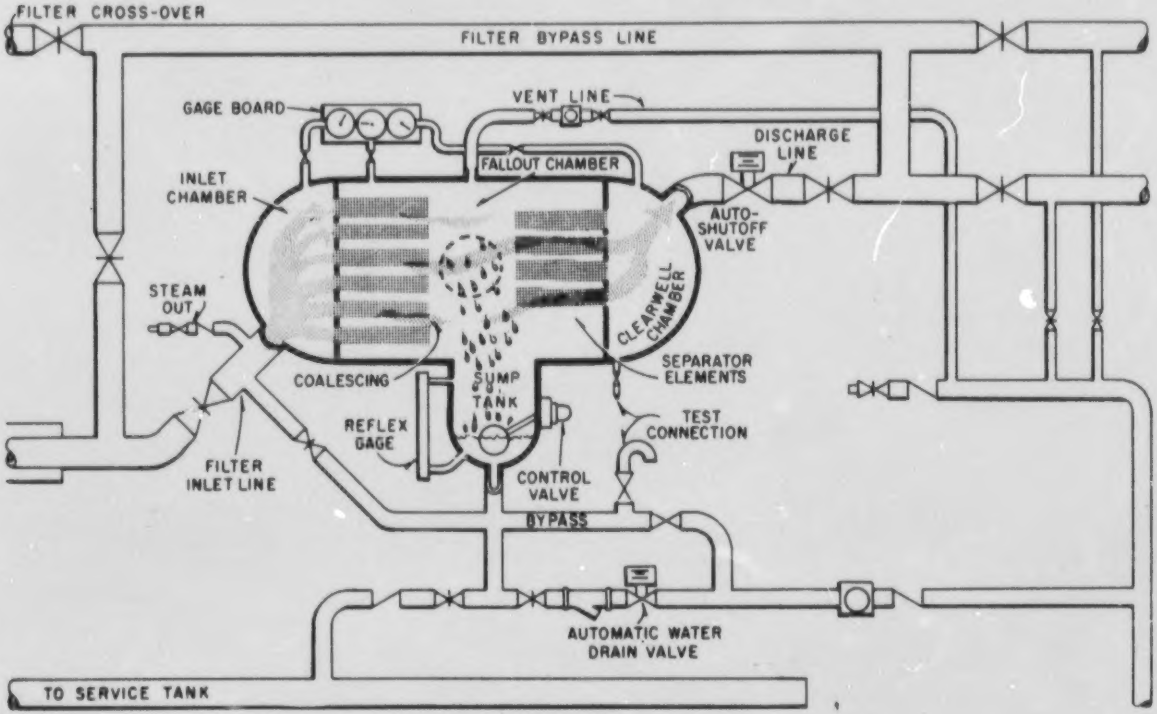
The interior of the filter shell is divided into three separate chambers–inlet, fallout, and outlet (clearwell). Both filtering media, coalescing and separator, are housed within the fallout (center) section of the filter. The number of each type element installed will vary, depending on the type and capacity of the filter; however, there are always more coalescing elements than there are separator elements.

The sump tank installed beneath the fallout section receives the water separated from the fuel. This tank also houses the controls for actuating the automatic water drain valve and fuel shutoff valve.

A reflex type sight glass gage is installed on the side of the sump tank for determining the water level within.

The drain piping, extending from the extreme bottom of the filter sump, is arranged to drain accumulated water overboard and clean fuel back to the service system. The water drain line contains a shutoff valve, "Y" type strainer, a hydraulically operated automatic water drain valve, a bull's eye sight glass gage, and a one-way check valve. A valved bypass line is installed around the automatic valve for manually draining the filter sump. This line also contains a valved test connection. The clean fuel drain line from the filter sump contains a shutoff valve and a one-way check valve.

Three pressure gages (one for each section of the filter) are installed on a gage board conveniently located in the filter room. These gages are used to determine the pressure drop across the filter elements.


FILTER CROSS-OVER
FILTER BYPASS LINE
GAGE BOARD
VENT LINE
DISCHARGE LINE
FALLOUT CHAMBER
INLET CHAMBER
AUTO-SHUTOFF VALVE
CLEARWELL CHAMBER
STEAM OUT
SEPARATOR ELEMENTS
COALESCING
SUMP TANK
REFLEX GAGE
TEST CONNECTION
FILTER INLET LINE
CONTROL VALVE
BYPASS
AUTOMATIC WATER DRAIN VALVE
TO SERVICE TANK

198.26

Figure 3-32.–Horizontal filter.

A filter vent line is installed at the extreme top of the fallout chamber. This line, fitted with a bull's-eye sight glass gage, two shutoff valves (one on each side of the gage), and a one-way check valve, terminates overboard.

A valved test connection, for taking frequent samples of fuel being discharged from the filter, is located in the bottom of the clearwell chamber.

JP-5 enters the filter at the bottom of the inlet section. The inlet line contains a steam out connection, back-flushing line, and a shutoff valve. The steam out connection is provided primarily for steaming the filters prior to maintenance; however, it is NOT necessary to steam JP-5 filters for the sole purpose of replacing elements. Proper ventilation will suffice. The back-flushing line was originally intended for reversing the flow through the filter shell to remove accumulated solids from the elements. This operation has long been suspended, elements must be replaced when clogged; therefore this line is now used solely for draining the inlet chamber of the filter.

JP-5 leaves the filter through the discharge line attached to the top of the clearwell chamber and the automatic shutoff valve.

The filters are also provided with a bypass line. This line, fitted with a shutoff valve, is installed between the filter inlet and discharge lines. The bypass line is used primarily for drain back; however, the filters are also bypassed during the initial flushing operation.

The filter crossover line (14, fig. 3-31), fitted with two shutoff valves (one at each end) interconnects the port and starboard filters via the bypass line. This arrangement enables any service station to be supplied with filtered fuel from either the port or starboard filter.

OUTBOARD DISTRIBUTION MAIN.–As the distribution piping leaves the discharge side of the service fuel filter, it is divided into two sections (legs). (See fig. 3-31.) Each leg extends outboard through the skin of the ship. One leg leads forward to supply all the service stations in the forward section of the quadrant, and the other leg leads aft supplying all the service stations in the after section of the quadrant. (This section of the distribution piping is referred to as the outboard distribution main.) The after leg of the forward quadrant and the forward leg of the after quadrant are cross-connected by a set of crossover valves. A valved venting connection is installed between these two valves. By proper alinement of the outboard distribution main crossover valves, it is possible to pressurize the entire port side of the ship from either the forward or after pumproom. Each leg of the outboard distribution main is provided with an emergency drain line. These lines are located in the filter room, and are fitted with locked closed shutoff valves. They are provided for the sole purpose of draining the outboard distribution piping in an emergency, such as a fire or explosion topside, and then, only on orders from proper authority in a position to observe the fuel being discharged.

CAUTION: These lines, although convenient, should never be used as a venting station when filling the distribution piping.

Some exposed JP-5 service system piping installed outboard along the ship's side is provided with a nontight U-shaped protective steel covering.

Isolation valves are installed at strategic points throughout the outboard distribution piping. These valves are normally in the open position and are closed only to isolate sections of the system in the event of damage. They are located in both the outboard distribution main and service station risers. The service station risers extend upward from the outboard distribution main to supply the service stations on the hangar and gallery decks. At the service station, the supply risers branch off and connect to each Blackmer fueling unit. A shutoff valve is installed in the supply line to each unit.

A valved venting connection is installed in the most remote service station riser in each leg of the quadrant, both forward and aft. These venting stations are used to vent the entire quadrant distribution system prior to starting a Blackmer service station.

Blackmer Service Station

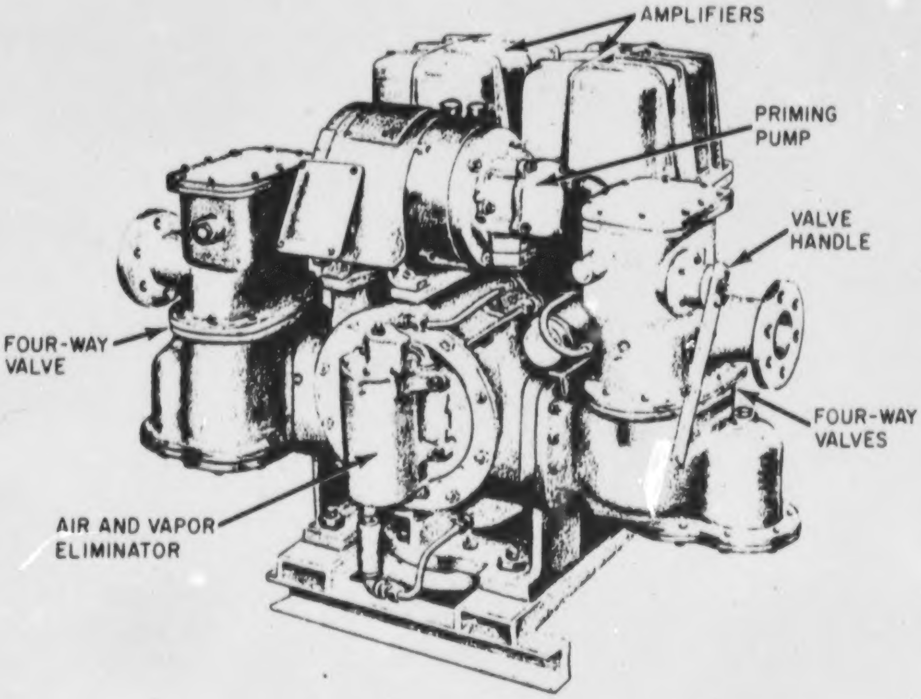
There are two Blackmer service stations presently in use in the fleet; one has a rated delivery capacity of 400 gpm and the other 200 gpm. Except for this and a slight difference in the pump impellers and four-way valves, they are practically identical. When servicing aircraft equipped with underwing pressure refueling, each unit is designed to deliver its rated capacity in gpm at 40 psi (as long as the riser pressure to the unit is maintained at 5 psi minimum). Both Blackmer units will defuel up to 100 gpm (as long as the riser pressure does not exceed 20 psi).

NOTE: Blackmer service stations that do not have a separate defueling main are not used for defueling. You go to the defuel position for the sole purpose of hose evacuation. You must use an air-motor driven portable defueling pump for JP-5 only.

Each fueling unit (fig. 3-33) consists of two complete centrifugal pumps in a single housing (driven by one electric motor), two semiautomatic four-way valves, two amplifiers, and the necessary piping and valves and electric controls to service aircraft through two hose reels.

The two four-way valves (one for each pump) control the flow of fuel to and from their respective pump and hose reel. The four-way valves are normally in the defuel (down) position and are locked in this position by a spring-loaded solenoid operated pawl (located in the upper part of the valve body) as long as the solenoid is deenergized. The valve is placed in the fuel position by manually raising the external valve handle 90°. As long as the solenoid is energized, the latching pawl will hold the valve in this position, allowing the handle to return to its normal position.

The solenoids are energized by electric current through the magnetic amplifiers which permit the flow of current to the solenoids as long as the low-voltage circuit through the fueling hose to ground is complete. Any interruption in the electrical circuit or break in the electrical ground to the aircraft will



197.35.1

Figure 3-33.—Blackmer fueling unit.

automatically return the four-way valves to the defuel position. The circuit can be broken manually by a toggle switch installed at the hose nozzle.

One hose reel on some ships is fitted with 1½-inch hard rubber hose, and the other has a 2½-inch collapsible hose. A shutoff valve is installed between each hose reel and the four-way valve.

As was previously mentioned in this training course, the Blackmer service units were designed to fuel and defuel aircraft simultaneously, but a standing order has been issued forbidding the defueling of any aircraft into the JP-5 distribution riser on the discharge side of the service fuel filter. This order eliminated the use of the defueling cycle of this unit, except for the sole purpose of deflating the hose after a fueling operation. Six portable air-motor-driven defueling pumps have been allotted for this purpose.

An independent defueling main with hose flushing adapters is being installed on ships equipped with the Blackmer fueling units. This line, which receives the defueled fuel and permits hose flushing prior to aircraft refueling, is connected to the downcomer at the main deck level. From here, it is directed into a preselected stowage tank via the JP-5 filling and transfer system.

Cla-Val Service System Piping

The quadrant distribution systems on ships equipped with the Cla-Val fuel/defuel valve fueling stations are similar. The only noted difference in any of the systems (CVA, LPH, and LPD), other than the number and size of the quadrants and the location and capacity of the service fuel filters previously mentioned, is the number of fuel/defuel valves installed at each fueling station. LPD's have only one fuel/defuel valve at each station, and the LPH's have only two, but a CVA may have as many as four. Each fuel/defuel valve is equipped with 150 feet of hose stowed on an attached hose reel. LPH's and LPD's use the 1½-inch hard rubber hose, and the CVA's use 2½-inch collapsible and noncollapsible hose. Regardless of the number of fuel/defuel valves, or the size hose installed, each individual station is provided with one (motor-driven) defueling pump.

DISTRIBUTION RISER.–The distribution riser described here is the forward starboard quadrant of a typical (CVA) Cla-Val fueling system, servicing a four-hose fueling station without reference to size or capacity. It is the most representative system for all ships. (Refer to fig. 3-31.) This is an entirely new piping installation, utilizing gate valves throughout the system, except on test connections and recirculating lines.

From the service pump common discharge header (on the seventh deck level), the distribution riser extends directly to the filter room on the third deck level. There is no pressure-regulating system installed in a JP-5 quadrant, since each fuel/defuel valve performs the function of regulating fuel pressure to the aircraft, and no fuel is returned through this line requiring a reduction in riser pressure.

FILTER.–Although the most common filter used in Cla-Val systems is the vertical type, the piping arrangement leading into, from, and between the port and starboard filters is identical to the Blackmer system.

There are some minor differences however, in the arrangement of the associated equipment, as shown in figure 3-34. Vertical filters have only two pressure gages installed for measuring the pressure drop across the elements. One is a differential gage installed between the inlet and fallout chamber and the other is a pressure gage located in the discharge line. The lower section of the fallout chamber, which houses the control valve for the automatic water drain and fuel discharge valves, is referred to as the filter sump. On the 2,000 gpm vertical filters the water drain line from the filter sump contains two automatic water drain valves.

OUTBOARD DISTRIBUTION MAIN.–The outboard distribution mains (15, fig. 3-31) are practically the same, except on some of the more modern ships, these lines are run inboard of the hull. Supply risers are run from the fore-and-aft main, up to the fueling stations on the hangar and gallery decks.

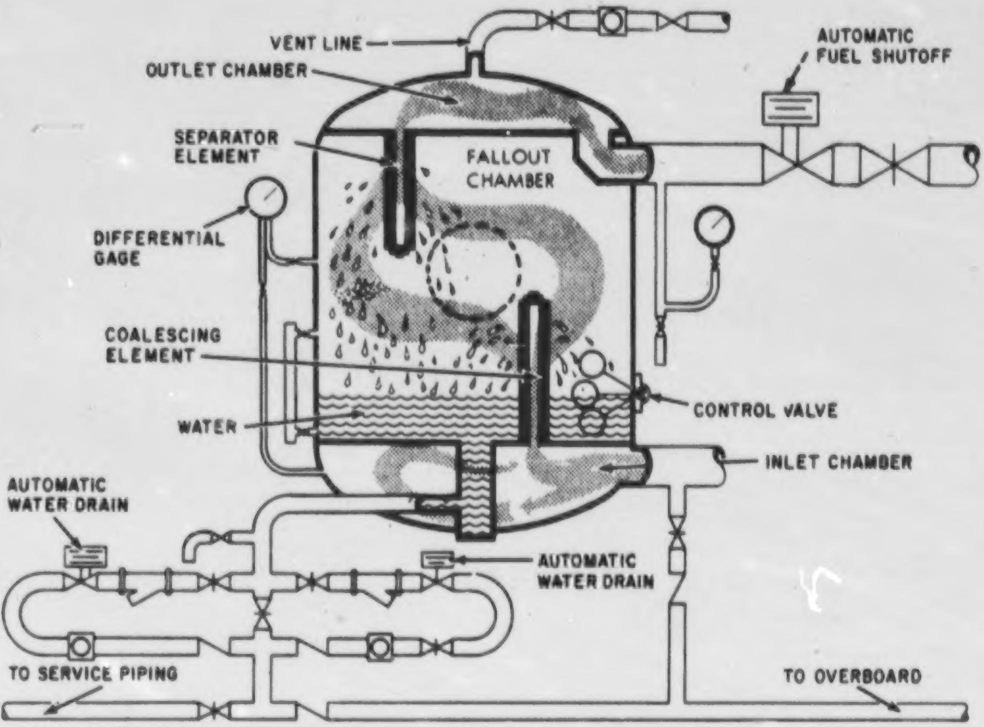

VENT LINE
OUTLET CHAMBER
AUTOMATIC FUEL SHUTOFF
SEPARATOR ELEMENT
FALLOUT CHAMBER
DIFFERENTIAL GAGE
COALESCING ELEMENT
CONTROL VALVE
WATER
INLET CHAMBER
AUTOMATIC WATER DRAIN
AUTOMATIC WATER DRAIN
TO SERVICE PIPING
TO OVERBOARD
197.32.1

Figure 3-34.—Vertical filter (2,000 gpm).

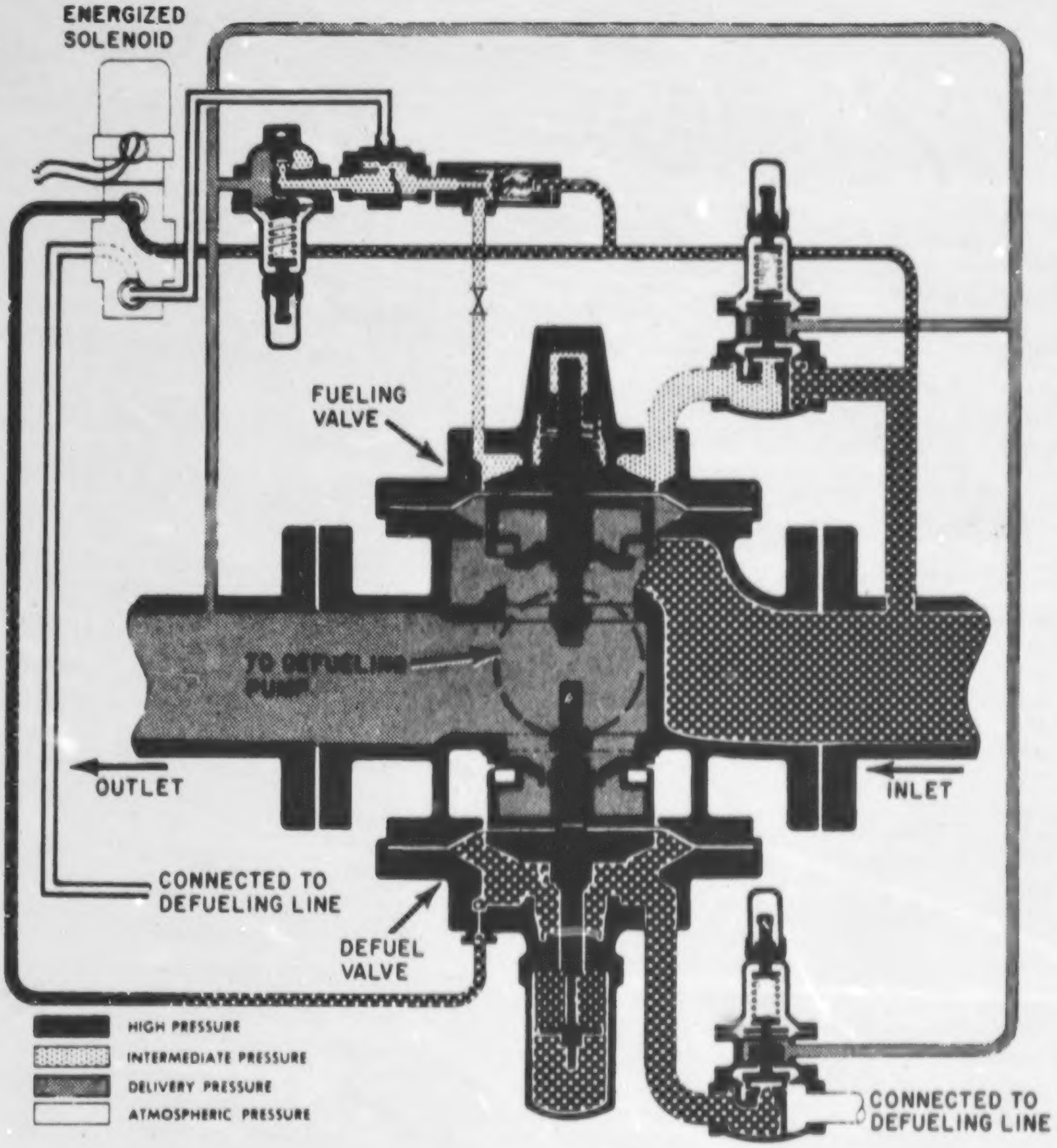
A fueling station consists basically of four fuel/defuel valves, four hose reels (with hose), one defueling pump (common to all valves) and the necessary piping, valves, and electrical controller to safely and efficiently operate the station.

At the fueling station, the supply riser branches off and connects to the inlet side of each fuel/defuel valve. This line contains a shutoff valve and a pressure gage connection. The outlet (discharge) line, provided with a pressure gage only, connects the fuel/defuel valve with its respective hose reel.

A third line fitted with a one-way check valve, connects the fuel/defuel valve with the common suction header of the defueling pump.

A cross-connection fitted with a "Y" type globe valve is installed between the fueling station supply riser and the inlet to the defueling pump. This line is orificed to provide a flow of approximately 5 gpm through the defueling pump to keep the pump cool and lubricated when the station is operating but no JP-5 is being defueled. At some preselected stations, a 10-inch spool is installed in the inlet piping to at least one fuel/defuel valve. The spool provides a means of attaching a portable meter. It is located between the inlet shutoff valve and the fuel/defuel valve.

The Cla-Val fuel/defuel valve shown in figure 3-35 consists basically of two individual, diaphragm-operated globe valves, housed in a single valve body. It is automatic in operation, utilizing line pressure as the working media. The positioning of the valves FUEL and DEFUEL within the main valve body is controlled by a solenoid-operated pilot valve. The valves are so arranged in the main valve body that they are normally in the defueling position (fuel valve


ENERGIZED SOLENOID
FUELING VALVE
TO DEFUELING PUMP
OUTLET
INLET
CONNECTED TO DEFUELING LINE
DEFUEL VALVE
HIGH PRESSURE
INTERMEDIATE PRESSURE
DELIVERY PRESSURE
ATMOSPHERIC PRESSURE
CONNECTED TO DEFUELING LINE

197.33.1

Figure 3-35.—Cla-Val fuel/defuel valve.

closed, defuel valve open) and will remain in this position as long as the pilot valve is deenergized.

The fuel/defuel valve operates basically as follows: When the solenoid-operated pilot valve is energized (fueling operation), high-pressure fuel is admitted to the cover chamber of the defuel valve holding that valve closed, allowing riser pressure acting under the disc to open the fuel valve, permitting fuel to be supplied to the aircraft. When the solenoid-operated pilot valve is deenergized (defueling operation), high-pressure fuel is admitted to the cover chamber of the fuel valve, holding that valve closed and allowing the defuel valve to resume its normal position, giving the suction side of the defueling pump access to the hose for defueling the aircraft. The defueling operation is also used to empty the hose after a fueling operation.

Additional control valves are incorporated in the fuel/defuel valve for regulating the pressure through the valve. When the START button on the motor controller for the defueling pump is depressed, the solenoid-operated pilot valve is energized by current through a magnetic amplifier as long as the low-voltage circuit through the fueling hose to ground is complete. Any interruption in the electrical circuit or break in the ground connection will automatically return the fuel/defuel valve to the defueling position. The ground circuit is controlled by an ON/OFF toggle switch at the hose nozzle much in the same manner as for the Blackmer stations.

It is possible to defuel one aircraft with the fuel/defuel valve equipped with the 2½-inch noncollapsible hose while simultaneously fueling other aircraft with any or all of the remaining hoses.

Each four-hose fueling station contains three 50-foot lengths of 2½-inch collapsible hose for fueling aircraft only and one 50-foot length of 2½-inch noncollapsible hose for defueling aircraft only. When not in use, the three collapsible hoses are stowed on hand-operated hose reels and the noncollapsible hose is stowed on a motor driven hose reel.

NOTE: Maintenance of the Cla-Val fuel/defuel valve is covered in chapter 9 of this manual.

The motor-driven defueling pumps are of the Blackmer positive displacement, rotary vane type. They are identical to those described in the filling and transfer system. The defueling pumps installed in the JP-5 system on CVA's have a rated capacity of 100 gpm at 15 psi. Those on the LPD's and LPH's are similar, except the defueling capacity is only 50 gpm at 15 psi. The pumps run continuously as long as the station is in operation. When defueling, the pumps discharge into an independent defueling main. The discharge piping from the pump to the fore-and-aft defueling main contains a one-way check valve and a shutoff valve.

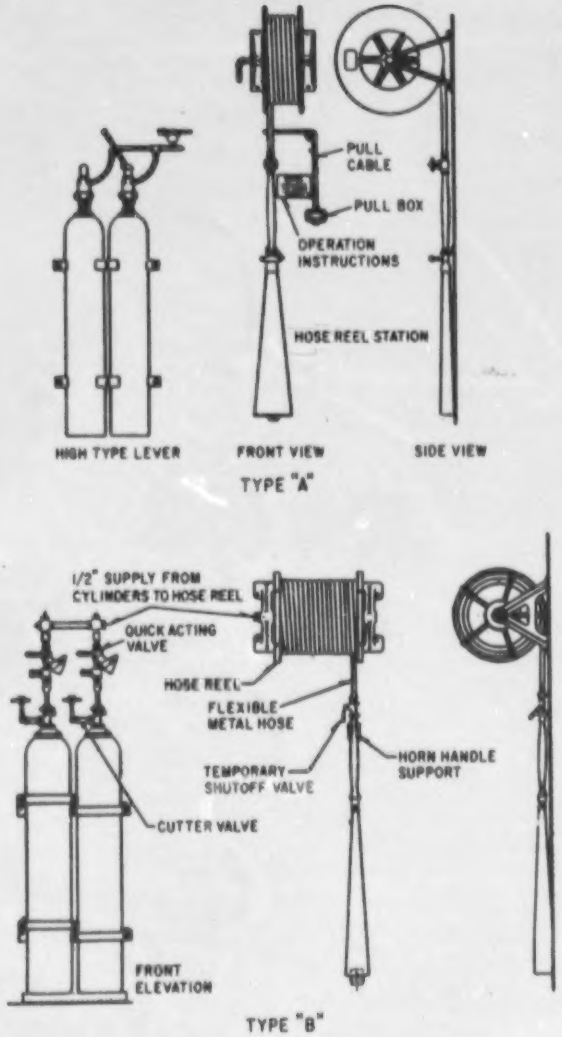
The mains run parallel to the outboard distribution piping and in some cases underneath the same nontight "U" shaped protective covering. Crossover valves interconnect the forward and after defuel mains just below the second-deck level. The after defuel mains connect to the downcomer of the filling and transfer system. Defueled fuel is thus directed via the fill and transfer system to preselected stowage tanks. Since there are no downcomers forward, the forward defueling main is connected directly into the forward section of the transfer main.

CO_2 PROTECTIVE EQUIPMENT

The CO_2 protective equipment provided for the JP-5 systems consists of the portable 15-pound CO_2 extinguisher and the 50-pound CO_2 bottles with attached hose reel. The type of equipment installed on the individual ships will depend in the most part on the size and arrangement of the pumprooms. Some ships may have the portable extinguisher located only in pumprooms, filter rooms, and at other strategic points throughout the system; whereas, others will have (in addition to the portable extinguishers) two 50-pound CO_2 bottles with attached hose reels installed in each pumproom. Except for size and releasing mechanism, the 50-pound cylinders are essentially the same as the 15 pound.

The hose-and-reel installation (fig. 3-36) consists of two 50-pound cylinders, a length of CO_2 hose on a reel, and a horn-shaped nozzle equipped with a second control valve. Presently, there are two different types in use; however, the only basic difference between the two is the method of releasing the CO_2 at the cylinders.

Type "A" uses a cable run from the release control on the cylinders to an operating handle


PULL CABLE
PULL BOX
OPERATION INSTRUCTIONS
HOSE REEL STATION
HIGH TYPE LEVER
FRONT VIEW
SIDE VIEW
TYPE "A"
1/2" SUPPLY FROM CYLINDERS TO HOSE REEL
QUICK ACTING VALVE
HOSE REEL
FLEXIBLE METAL HOSE
TEMPORARY SHUTOFF VALVE
HORN HANDLE SUPPORT
CUTTER VALVE
FRONT ELEVATION
TYPE "B"

198.27

Figure 3-36.—CO_2 hose-and-reel installation.

which is set near the reeled hose. Type "B" uses local control valves at the cylinder head.

To operate either type, proceed as follows:

1. Make sure the horn valve is in the CLOSED position.
2. On local control, open the valve in the pipeline above the cylinder intended for use.
3. Release carbon dioxide from the cylinder by pulling the control handle at the cylinder or at the reel (for cable type).
4. The discharge of CO_2 at the base of the fire can now be controlled by the horn valve.

Like the portable extinguisher, the CO_2 can be turned on and off as the work on the fire-fighting progresses; but, also, like the portable disc type extinguisher, it cannot be made leak-proof until each cylinder is again sealed with a new sealing disc.

The CO_2 equipment provided in the JP-5 pumprooms is considered adequate, since fires in these spaces usually are not of an extent that require total flooding, or they are discovered before they reach such an extent. The CO_2 can therefore be applied directly to the fire. Furthermore, there is no danger to personnel from accidental discharge, inasmuch as two control valves must be opened to release the CO_2.

In the event a pumproom fire should get out of control and require total flooding, take the following precautions:

1. Secure the pumproom ventilation.
2. Release all available CO_2.
3. Secure all access hatches to the pumproom on departing.

To insure readiness in case of fire, cylinders should be weighed when received aboard and thereafter as follows:

1. 15-pound portable extinguishers monthly.
2. 50-pound cylinders when installed and semiannually thereafter.

Any cylinder found to weigh less than 90 percent of its proper weight should be refilled. The integrity of the lead wire seal on 15-pound extinguishers should be determined as a part of the regular weekly compartment inspection. Cylinders with missing or broken seals should be weighed immediately and restored to proper readiness. All cylinders should be stored in the coolest part of the spaces.

CHAPTER 4

OPERATION OF THE JP-5 SYSTEM

RECEIVING JP-5 ABOARD

The first significant replenishing operation ever performed at [illegible] by the U. S. Navy was in 1899, when the U. S. Navy collier, Marcellus, while towing the U. S. S. MASSACHUSETTS, transferred coal to her. Since that time, many methods and procedures have been tried and abandoned. Those described in this chapter have been adopted as the most feasible and are currently used in the fleet. The actual rigging of the replenishing hose between ships is the responsibility of the deck force and is not discussed in this chapter. The ABF is concerned with only the filling connection hookup and the procedures for receiving JP-5 aboard.

The receipt of aviation fuel aboard carriers is a continuing problem in the fleet. This is due, in most part, to the hazardous nature of the fuel involved, and the ever increasing quantity required for our modern day aircraft. Other factors of equal importance which must also be considered are the type and location of the operation, the time allotted, and the large number of personnel involved.

The type and the location of the refueling operation refer to the supplying source and geographical location; such as, from a barge at anchorage in the harbor, when moored to a pier, or replenishing from a tanker underway. The dangers involved are progressively greater in each operation in the order listed.

Time is an ever important aspect in any refueling operation, but more so at sea. The entire Task Force is scheduled to be replenished on a given date, and each ship is allotted a maximum time for this purpose. Not only are ships in constant jeopardy of a fire or collision during the replenishing operation, but they are also a prime target in the event of an enemy attack.

JP-5 fuel is comparatively safe (having a minimum flashpoint of 140° F) when in its stored state. However, this same fuel handled under high pressure is extremely dangerous when released into the atmosphere in a fine mist or spray. Therefore, it should be treated accordingly, and every precaution should be taken to prevent the possibility of a fire or explosion when pumping this fuel.

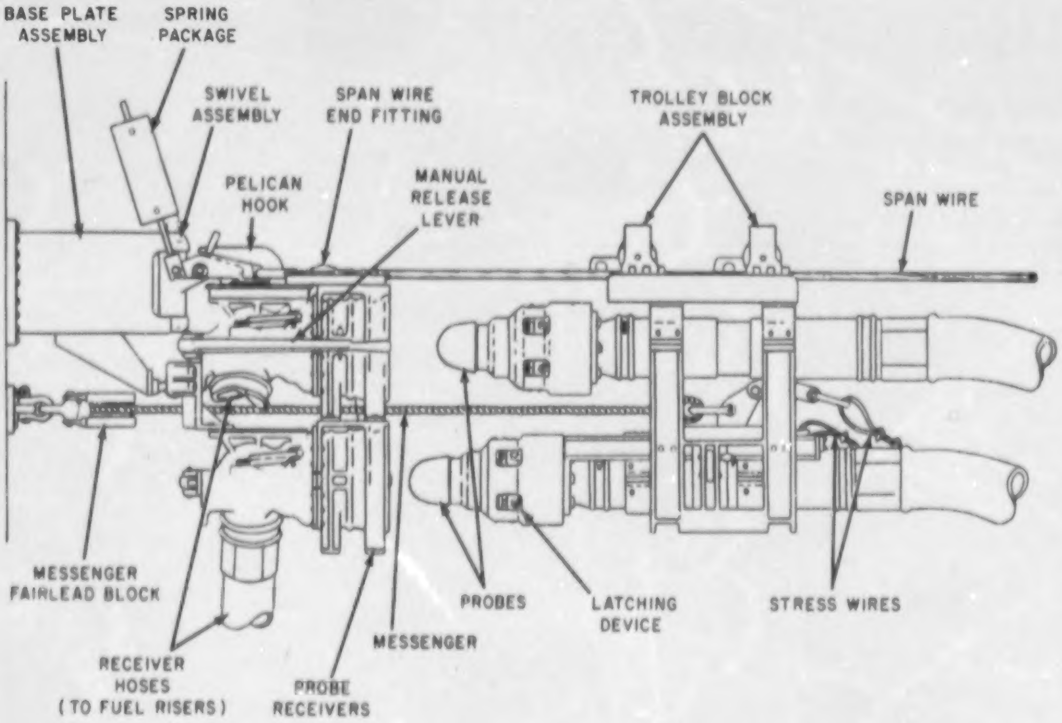
The men required in a refueling operation include personnel of the entire V-4 division, those from other air department divisions, as well as those from other department divisions; i.e. gunnery, engineering, etc. These men are stationed throughout the ship. Therefore, it is imperative that close communications be maintained with all hands concerned at all times during the replenishing operation.

A replenishing operation from a tanker was chosen to be described here since it covers all phases of any refueling operation.

The procedure for receiving JP-5 fuel aboard is basically the same for all class carriers. This chapter deals with the general procedures, equipment used, and the criteria for the acceptance or rejection of JP-5 fuel without reference to any particular ship.

The rate of fuel received can be increased by using a double-hose rig. (See fig. 4-1.) Two hoses are suspended, one below the other, from a single span wire. With this rig, two kinds of fuel may be received simultaneously at a single station, or one kind may be pumped through both hoses.

For more detailed information as to equipment, tools, and personnel required on


BASE PLATE ASSEMBLY
SPRING PACKAGE
SWIVEL ASSEMBLY
SPAN WIRE END FITTING
TROLLEY BLOCK ASSEMBLY
PELICAN HOOK
MANUAL RELEASE LEVER
SPAN WIRE
MESSENGER FAIRLEAD BLOCK
PROBES
LATCHING DEVICE
STRESS WIRES
MESSENGER
RECEIVER HOSES (TO FUEL RISERS)
PROBE RECEIVERS

198.107

Figure 4-1.—Double probe and receiver.

your particular ship, consult your Ships Organization and Regulation Manual, and Replenishment at Sea Manual, NWP38 (Series).

PREPARATIONS

Prior to receiving the tanker alongside, certain preparations are necessary to safely and efficiently expedite the replenishing operation. These preparations can be listed under two categories as follows:

1. Below-deck preparations.
2. Topside preparations.

It can be assumed that many of the steps listed in the two may be performed simultaneously; but for clarity, they are covered separately in this chapter.

Below-Deck Preparations

Ballasted JP-5 tanks should be deballasted and stripped as soon as possible after the date and time of the replenishing operation have been confirmed. Actual pumping of ballasted tanks must be in strict accordance with the sequence tables set up by damage control central in order to maintain the list and trim on the ship. Obtain assistance from personnel in the engineering department. They will aline the main drainage system as required and operate the main drainage eductors.

The pumproom or manifold operators aline the tank stripping system as follows:

1. Unlock and open the main drainage cutout valve on the flood and drain manifold. (Relock manifold.)

2. Open the valves on the single-valved stripping manifold to the tanks to be deballasted.

NOTE: All tanks interconnected with one flood and drain manifold can be deballasted simultaneously. Each eductor can deballast an average of 1,000 gpm when supplied with fire main pressure of about 150 psi.

Because of the tremendous suction taken by the main drainage eductors, loss of suction on the tanks is most likely to occur before the tanks are completely emptied. When this occurs, realine the tank manifolds to use the tank stripping system as follows:

1. Close all valves in the single-valved stripping manifold.
2. Unlock and realine the flood and drain manifold valves by closing the main drainage eductor cutout valve and opening the stripping main suction cutout valve (relock the manifold valves).
3. Aline the piping from the flood and drain manifold to the suction side of the motor-driven stripping pumps.
4. Aline the pump discharge piping to overboard via a fuel oil tank drainage system. (Request assistance from the engineering department.)
5. Open one valve on the single-valved stripping manifold.
6. Start the stripping pumps, and strip each tank one at a time until they are completely empty of all ballast water.

(Note: Observe suction and discharge pressures during stripping operations to prevent the pump from running dry.)

7. Secure the flood and drain manifold and close all valves in the single-valved manifold.

By use of the motor-driven stripping system, strip all stowage tanks that are to be used in both the receiving operation and the internal transfer operation prior to receiving JP-5 aboard.

NOTE: Verify all stripping operations by sounding the tanks, using water-indicating paste.

Strip the slack (partially filled) service tanks, using the hand-operated stripping system.

CAUTION: Ships planning to replenish in port MUST deballast and strip tanks prior to entering.

SOUNDING TANKS.—Verify all stripping operations by sounding the tanks, using WATER-INDICATING paste; BOTTOM-THIEF a sample and log its quality.

The tank gaging equipment (static head liquid level indicator) indicates only the amount of liquid in the tank. It does not indicate the amount of water. The only positive way of determining the actual contents of a tank is to sound the tank with sounding tape, using water-indicating paste and then bottom-thiefing a sample.

SOUNDING EQUIPMENT.—Sounding tapes (fig. 4-2) are 50-foot steel tapes graduated in feet and inches (inches graduated to 1/8's). The bitter end is fitted with a snap-hook for attaching a plumb bob or thief sampler. The first

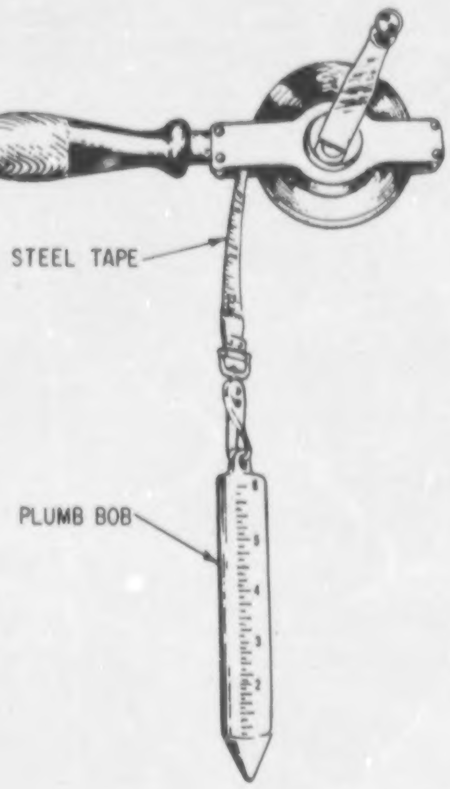


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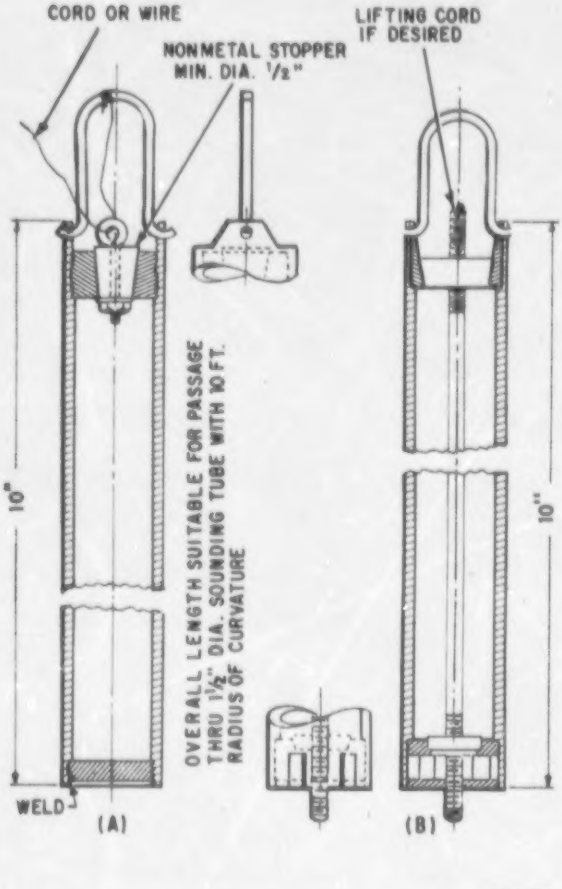
Figure 4-2.—Sounding tape.

9 inches of the tape consists of the plumb bob and snaphook. These tapes are usually plain, but can be ordered in color, i.e. black on white or white on black.

Water-indicating paste presently in use aboard ship comes in tubes and may be ordered in either the 2½- or 3-ounce size.

There are two types of thief samplers (shown in fig. 4-3). These samplers may be made up locally or obtained from a naval repair activity. Both can be used in a standard 1½-inch diameter sounding tube. Type A is used where it is not necessary to obtain a sample from the very bottom. Type B can be used (if rigged properly) for any level or bottom sampling.


CORD OR WIRE
NONMETAL STOPPER MIN. DIA. ½"
LIFTING CORD IF DESIRED
OVERALL LENGTH SUITABLE FOR PASSAGE THRU 1½" DIA. SOUNDING TUBE WITH 10 FT. RADIUS OF CURVATURE
10"
10"
WELD
(A)
(B)

198.29

Figure 4-3.—Thief samplers.

SOUNDING PROCEDURE.—Spread a thin coating of water-indicating paste from the tip of the plumb bob to approximately the 2-foot mark on the tape. Lower the plumb bob through the sounding tube until it touches the striker plate. The tape must be kept taut; i.e., no slack which would cause an inaccurate reading. Slowly withdraw the tape. The highest level where the JP-5 "wets" the tape is read in feet and inches. This reading is then converted to gallons by use of a tank capacity (curve) manual. When the plumb bob is removed, note the change of color of the paste. The normal color, when applied, is gray. When water is present, the paste turns RED to the level of water in the tank. This level, in feet and inches, is converted to gallons and subtracted from the JP-5 reading for a more accurate determination of the quantity of JP-5 in the tank.

Knowing the amount of water in the tank will also assist in determining the time required for the stripping operation.

To obtain a sample from the very bottom of the tank, remove the plumb bob and attach the type B sampler shown in figure 4-3. Lower the sampler into the sounding tube. (The distance from the sounding tube cap to the striker plate will have been determined during sounding operations.) As the tip of the valve disk guide touches the striker plate, it will be depressed by the weight of the sampler, raising both upper and lower disks off their seat. After remaning in this position momentarily, retract the sampler and dump the contents into a clean jar.

If water droplets or discoloration are noted on the sounding tape during the sounding and bottom sampling procedure, it is an indication of entrained or free water in the tank. Should this occur, it will be necessary to take a composite sample.

A composite sample is one in which samples are taken from different levels in the tank and mixed to form one sample. This type sample is more representative than one taken from only top and bottom. The same type sampler used to take the bottom sample can be used to take a composite sample, simply by attaching a string to the upper part of the disk guide stem. The sampler can then be opened at various levels by giving a smart jerk on the string.

Tanks found to be contaminated with entrained water must be allowed more settling time before transferring.

INTERNAL TRANSFER.–Top off all slack service tanks. This will allow a longer settling time for the JP-5 being received. Consolidate the fuel load by transferring from slack stowage tanks to completely fill as many tanks as possible. This will reduce the number of tanks to be filled and will minimize the number of tanks affected in the event contaminated fuel is received.

NOTE: When consolidating the fuel load, it is recommended that pumping be from forward to aft. Modern ships are designed to operate with no trim; however, if the ship must be trimmed when consolidating the fuel load prior to replenishing, it is desirable, especially on aircraft carriers, that they be trimmed by the stern.

CAUTION: When transferring fuel internally or receiving fuel aboard, the overflow tank for every nest of tanks scheduled to receive fuel **must be empty before fuel can be introduced into any tank in that nest.**

FILLING SEQUENCE.–Before receiving fuel, the JP-5 oil king should have soundings or readings taken on all stowage and service tanks. A statement showing the amount and location of all JP-5 on board must be submitted to the officer in charge of the fueling operation. It is the responsibility of the JP-5 oil king to know how much fuel is on board, where it is located, how much more can be received, the order in which the tanks should be filled, and the approximate duration of the receiving operation.

To determine the amount of JP-5 to be received, add the total capacity in gallons of each empty stowage tank plus the amount required to top off any slack tanks. The order in which the tanks will be filled (the filling sequence) should be coordinated with damage control central to maintain the proper list and trim on the ship. In determining the filling sequence, allow for a minimum of six tanks (three port and three starboard) on the line at all times. Knowing in advance the order in which the tanks will be filled will greatly assist in the assignment of sounding teams, manifold operators, and the overboard discharge observers.

Three factors are involved in determining the duration of the receiving operation: (1) the amount to be received (previously determined), (2) the maximum receiving rate of the particular ship, and (3) the normal pumping rate of the individual tanker. The latter two can be gained through actual experience and information recorded in the receiving log; however, if this is the first experience with the tanker, the pumping rate can be obtained in advance via radio messages to the tanker.

Topside Preparations

Preparations to be made topside by V-4 division personnel are not as numerous and time consuming as those below decks, since most of the actual rigging for receiving the tanker is the responsibility of the deck divisons. However, there are certain pieces of equipment that must be assembled by repair team personnel at or near the refueling station, in order to safely and efficiently expedite the operation.

Repair team personnel should insure that the filling connection is equipped with a pressure gage, thermometer, sampling connection, low-pressure air connection, and a flushing valve. They should also insure that the male end of the quick-release coupling and/or probe receiver is attached and in good working order.

NOTE: Due to the difficulty encountered in releasing the Robb quick-release coupling during emergency breakaway, **some ships require a breakable spool installed between the 90° ell and the male end of the quick-release coupling.** (See fig. 4-4.)

The breakable spool is in addition to the one required on some ships for attaching the flushing valve. It is weakened by a groove around its outer circumference so that it can be easily broken by a sharp blow from a sledge hammer, if emergency conditions so require.

The equipment to be assembled at or near each refueling station by preassigned personnel includes the following:

1. Proper handtools.
2. Drip pan.

3. Rags.
4. Swabs.
5. Speedy dry.
6. Buckets (rubber or brass).
7. Five-gallon safety can.
8. Length of low-pressure airhose.
9. Length of refueling hose (as required).
10. Length of hose—attached to flushing valve (as required).
11. Two pry bars—for emergency disconnect.
12. One sledge hammer (as required).
13. Two telephone headsets.
14. The receiving logs.
15. Clean sampling bottles and tags for identification of samples.
16. Several portable 15-pound CO_2 and/or P-K-P extinguishers.
17. Two 2½-inch firehose—fully charged.
18. Two 2½-inch firehose with 12-foot applicators—fully charged.
19. Two 2½-inch foam hose—not charged.

NOTE: The fog foam pumping unit is manned by the engineering department.

The type and number of pieces of firefighting equipment to be laid out in the vicinity of the refueling station must be in accordance with the ship's fuel handling bill. Listed above are the recommended minimum requirements on a typical CVA.

During the refueling operation, two separate sound-powered telephone circuits are manned by V-4 division personnel. One is the carrier 4JG (the AvFuels system circuit), and the other

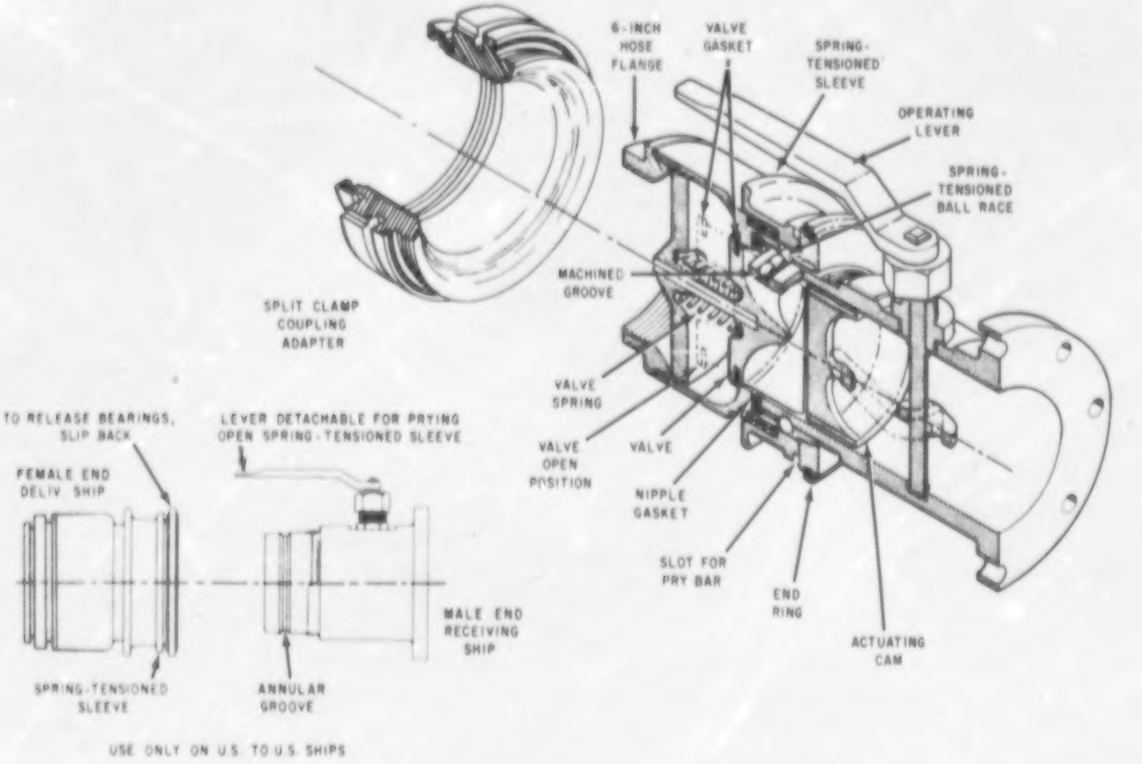

6-INCH HOSE FLANGE
VALVE GASKET
SPRING-TENSIONED SLEEVE
OPERATING LEVER
SPRING-TENSIONED BALL RACE
MACHINED GROOVE
SPLIT CLAMP COUPLING ADAPTER
VALVE SPRING
VALVE OPEN POSITION
VALVE
NIPPLE GASKET
SLOT FOR PRY BAR
END RING
ACTUATING CAM
TO RELEASE BEARINGS, SLIP BACK
LEVER DETACHABLE FOR PRYING OPEN SPRING-TENSIONED SLEEVE
FEMALE END DELIV. SHIP
MALE END RECEIVING SHIP
SPRING-TENSIONED SLEEVE
ANNULAR GROOVE
USE ONLY ON U.S. TO U.S. SHIPS

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Figure 4-4.—Combined quick-release (Robb) coupling and valve.

furnished by the supplying source, is from ship-to-ship.

To expedite communications, position the filling connection and ship-to-ship telephone talkers close to the officer or CPO in charge of the refueling operation. The ship-to-ship telephone talker should have the telephone lead ready to establish communications as soon as the telephone jackbox is received from the tanker.

CAUTION: To avoid injury, the ship-to-ship telephone talker should not fasten the telephone neck strap.

Telephone talkers are stationed at the following locations on the circuits indicated:

1. Filling connection (two talkers–one on the 4JG, and the other on the ship-to-ship).
2. Flight deck control (4JG), as required.
3. Sounding tube locations (4JG).
4. Overboard discharge sentry (4JG).
5. Pumprooms (4JG).
6. Manifold spaces (4JG).
7. Damage control center (4JG).

All telephone headsets must be tested well in advance of the receiving operation.

A fueling watch list should be posted well in advance–at least 24 hours whenever possible. In addition to the posted list, each man should be informed of his station and instructed in his duties. During the instruction period, emphasis should be placed on safety, emergency breakaway procedures, and hazards. Assign only experienced and capable men to actually perform the duties. Limit the number of trainees, especially at the filling connections; too many men at this station are not helpful and may confuse the operation by getting in the way. Whenever possible, rotate experienced men to other stations. This will not only give the individual the broadest training possible, but will also produce a more flexible division.

As a rule, fueling stations should be manned half an hour before fueling time. The refueling stations to be manned and their locations are as follows:

1. Fire Party–located on the hangar deck near the filling connection. (This station is manned by other air department personnel as required.)

2. Overboard discharge observer–located on catwalks, sponsons, or weather decks to observe and report the overflow from the overflow tanks.

3. Filling connection personnel–located at the filling connections. (Repair team personnel make the actual hook up.)

CAUTION: Personnel working at the filling connections should wear a life jacket (kapok only), construction type (safety) helmet or battle helmet, whistle, and pin-on flashlight.

4. Anticontamination sentry–located at the filling connection to take samples as prescribed by the aviation fuels officer.

5. Sounding teams–stationed in necessary compartments where sounding caps are located.

NOTE: Sounding teams should be equipped with a sounding kit which contains the following:

a. Sounding tape (plumb bob safety-wired to tape).
b. Water-indicating paste.
c. Rags.
d. Pencils.
e. Tank sounding cards.
f. Flashlight (explosion-proof).
g. Sound-powered telephone headset.
h. "T" wrench (for sounding caps).
i. Spare gaskets (for sounding caps).

6. Manifold operators–located in pumprooms or manifold spaces.

7. Liquid level diagram recorder–located in damage control central.

RECEIVING OPERATION

Immediately upon manning a station, communication should be established. When all stations have reported manned and ready, the JP-5 filling and transfer system should be lined up for receiving JP-5. Open the following valves:

1. Below decks at the base of the downcomer.

NOTE: Where downcomer valves are located in machinery spaces, valve flange gaskets should be checked for tightness to prevent leakage into spaces.)

2. All transfer main bulkhead cutout valves.

3. Transfer main branch header valves leading to the manifold of the tanks to be filled.

4. The transfer main side manifold valves of all tanks to be filled.

5. Tank side manifold valves to a minimum of six tanks (three port and three starboard).

CAUTION: Insure that all telltale valves on the manifolds are closed. The below-deck piping and valves are now alined for receiving JP-5 aboard.

Just prior to receiving the tanker alongside, specific action must be taken by certain departments to insure maximum safety and security during the replenishing operation.

The officer of the deck controls the smoking lamp. The operations watch officer insures that certain high-frequency transmitters, radars, and other electronic equipment in the vicinity of the fueling stations are secured. The damage control watch officer insures that additional fire main pumps are put on the line and that the fog foam pumping unit is manned. The aviation fuels officer insures that no mobile equipment or electrical winches (not required in the replenishing operation) are operated within 50 feet of the fueling station.

As the ship makes its final approach and steadies alongside, heaving lines or shot lines are sent over from each station. By means of these first lines, the telephone cables, distance line, and hose messenger are sent back. As soon as communication is established between stations, the JP-5 oil king clarifies with the tanker final information such as, tanker's maximum pumping rate and discharge pressure and carrier's maximum receiving rate and pressure.

When using the Robb type refueling rig, inspect the female half of the quick-disconnect coupling to insure that the sealing gasket is in place and in good condition. Also make sure that all three valve disk guides are intact. If the sealing gasket is missing or distorted in any way, the coupling will leak. If any one of the valve disk guides is broken off, it will be impossible to open the valve in the quick-disconnect coupling. In the event either of the above two discrepancies is noted, send the hose back to the tanker for repair. After the female half has been inspected and found to be satisfactory, couple the hose to the filling connection.

When using the Probe type refueling rig, check each of the six lock arm assemblies for broken or missing lock arms; insure that all lock arms are in a locked position. When the probe is properly mated with the receiver the indicator flag will raise approximately 30 degrees (fig. 4-5), indicating transfer of fuel may commence.

NOTE: The actual hookup of the fueling hoses is accomplished by personnel from the Deck department.

Before receiving JP-5 into the stowage tanks, samples should be taken at the main deck fill connection in containers that permit visual inspection. If acceptable fuel is being received open the downcomer, close the flushing valve, and insure a minimum number of stowage tanks are on the line. Start replenishment of aviation fuels at a slow rate.

When JP-5 enters the tanks, as indicated by the liquid level indicators or sounding teams, order the tanker to start pumping at a normal rate. Log the starting time and continue taking samples to insure the receipt of clean, bright, water-free JP-5. Log the quality of the samples taken and pressure of the JP-5 being received at the hangar deck filling connection.

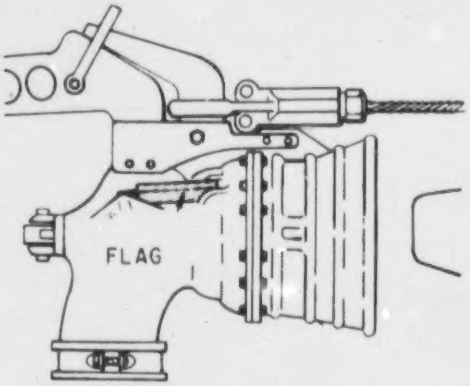
The receiving pressure at the filling connection should be approximately 40 psi in order to obtain the designed maximum filling rate. Some of the larger CVA's can receive JP-5 at a rate of 360,000 gallons per hour when using two stations.

As the stowage tanks are being filled, the volume of fuel in each tank is constantly checked by observing the liquid level indicators and by sounding the tanks.

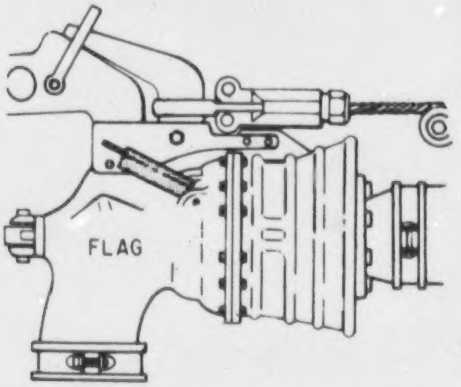
CAUTION: Commence sounding at the initial flow. In general, the tanks nearest the downcomer will fill first.

Sounding should be taken periodically until the tanks reach 80 percent capacity. From this point on, soundings should be continuous.

When 80 percent capacity is reached in the first nest of tanks opened, open the tank side valve to another nest (minimum of six tanks—three port and three starboard) at the



PROBE DISENGAGED FROM PROBE RECEIVER.
LATCH INDICATOR FLAGS IN STOWED POSITION.



PROBE MATED WITH PROBE RECEIVER.
LATCH INDICATOR FLAGS RAISED APPROXIMATELY 30° ABOVE THE HORIZONTAL.

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Figure 4-5.—Latch indicator flags.

same time, throttle the TANK SIDE valves to the first nest of tanks, and top them off to at least 95 percent capacity. All stowage tanks, except overflow tanks, can be filled to almost 100 percent to increase the amount of fuel carried on board.

NOTE: JP-5 tanks are not fitted with steam heating coils (as are the standard fuel oil tanks); therefore, room for expansion for this purpose is not necessary. The overflow tanks are limited to 95 percent to allow for expansion due to normal temperature changes.

All stowage tanks in one nest, both port and starboard, can be opened for simultaneous filling, but care must be exercised when topping off to prevent overtaxing the overflow line.

CAUTION: Overflow mains for overflow tanks are designed for an overflow rate of 1,500 gpm, and each stowage tank has an overflow rate of 500 gpm.

The liquid loading diagram recorder, stationed in damage control central, marks each full tank with an "F" as soon as word is received over the 4JG circuit.

After the amount of JP-5 being received per minute has been determined, the tanker can be given a "stop pumping" time.

NOTE: The fueling operation given in this chapter is for loading the forward tanks first and then the after tanks. However, it should be noted that all tanks both forward and aft can be opened for simultaneous filling. All CVA's fitted with two downcomers (one forward and one aft) utilize both to expedite the refueling operation. The number of tanks that can be opened and the method of receiving will vary on the individual ships, depending on the number of personnel available as manifold operator, sounding teams, etc., and the experience gained after several refueling operations.

While the forward group of stowage tanks is being filled, the below-deck crew is lining up the after group in the same manner as previously described. All valves EXCEPT the transfer main bulkhead cutout valve nearest the downcomer in the after pumproom are opened to the after group of tanks to be filled.

When the last port and starboard tanks are 80 percent full, open the transfer main bulkhead cutout valve leading to the after group of tanks. The after group of tanks are filled in the same manner as the forward group. Continue topping off the remaining tanks forward.

NOTE: On ships that are equipped with the Cla-Val service station, an adequate number of stowage tanks in each group must remain empty to receive the recirculated fuel from these stations.

When the last port and starboard tanks to be filled reach 80 percent capacity, notify the tanker to reduce pumping. Top off the last tanks. When the overflow tanks reach 95 percent capacity, order the tanker to stop pumping.

Close the gate valve at the filling connection at the hangar deck level.

If the Robb type connection is used, slowly admit low-pressure air at the filling connection and blow the JP-5 in the hose back to the tanker. When the tanker indicates that the hose is empty, bleed the air out of the hose through the sample connection, close the valve in the quick-disconnect coupling, uncouple the hose, and return it to the tanker.

If the probe system is used, it is not necessary to blow back the fuel in the hose; however, if draining the fuel from the hose is required by the delivery ship, a sleeve retractor (fig. 4-6) is provided for manually opening the sliding sleeve valve in the probe; this retractor is also used to provide access when replacing the probe nose seal.

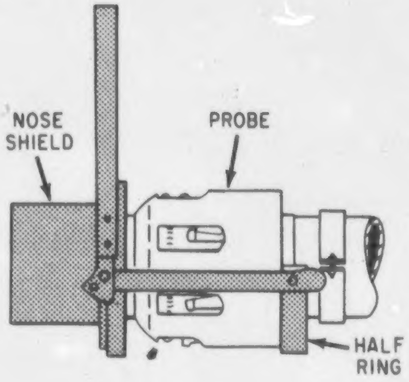
At the completion of the replenishing operation, notify the officer of the deck of the start and stop pumping time and the total gallons received. This information is entered in the ship's log.

Secure and restow all equipment. If a length of refueling hose was required for this operation, purge it with CO_2 and cap both ends before stowing. Close all valves in the filling and transfer system. This system must remain full of JP-5 at all times to reduce the amount of water accumulation due to condensation. The tank top manhole covers should be inspected for leaks and the tanks sounded to obtain an accurate account of all JP-5 on board. During the final soundings, compare readings with the liquid level indicators and make adjustments as necessary.

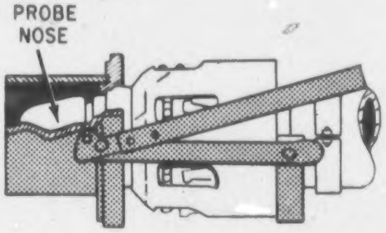
Criteria for Acceptance or Rejection of JP-5

The standards of fuel cleanness (table 4-1) are established as maximum limits for transfer of aviation fuels between shore activities and ships. Normally, contamination levels are maintained substantially below these levels.

A minimum of 5 gallons of JP-5 is drawn (in small quantities) from the filling connection during the refueling operation. At any time a sample exceeds the contamination limits listed in table 4-1, the pumping operation must cease. The final decision of acceptance or rejection of the fuel rests on the commanding officer.



INSERTING PROBE



RETRACTING PROBE SLEEVE VALVE

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Figure 4-6.—Sleeve retractor.

EMERGENCY BREAKAWAY

During a refueling at sea operation, any number of unforeseen circumstances could occur, making an emergency breakaway necessary. For this reason, a sufficient number of well-trained personnel must be stationed at the filling connection ready to disengage the rig. The tanker must be ready to stop pumping the moment an emergency becomes apparent, or when breakaway is ordered.

The order for an emergency breakaway may be given by the commanding officer of either

Table 4-1.–Standards of fuel cleanness

From	To	Max. sediment (See Note 1)	Max. water (See Note 2)
Shore Tankage	Barges, Tankers, Fleet Oilers, Carriers	8.0 mg/liter	No visible
Fleet Oilers, Barges, Tankers	Carriers	10.0 mg/liter	No visible
Carriers, Fleet Oilers, Barges, Tankers	Shore Tankage	10.0 mg/liter	No visible

NOTE 1: Sediment levels are to be determined by laboratory analysis, or by the AEL Mk III Contaminated Fuel Detector.

NOTE 2: The free water content is determined by the AEL Mk I Free Water Detector Kit, and by laboratory analyses.

the receiving ship or the delivery ship. Paramount in ordering an emergency breakaway is the allowance of sufficient time for the ships to disconnect the rigs in an orderly manner. Fueling rigs are subject to severe damage if not properly released at the breakaway signal, and serious injury to personnel could occur.

An emergency breakaway may be accomplished smoothly, rapidly, and safely, if the men at the station know how and what to do first. The proper sequence for an emergency breakaway using the Robb connection is as follows:

1. Stop pumping.
2. Free the hose. Use any one of the approved methods, but in the order listed. First, relieve the strain on the hose by hauling in on the riding line. (If time permits, manually close the valve in the female half.) By use of pry bars or spanner, retract the sleeve and disengage the quick-release coupling. If the sleeve cannot be retracted, then, secondly, with the valve in the female end closed, use a 10-pound sledge, and strike the breakable spool sharply. Do not cut the riding line; use it to ease the hose over the side. The third and last course of action is to cut the hose loose with a fire ax.
3. Release the span wire. Telephone and distance lines can be returned as soon as the word is passed fo[illegible]akaway, but talkers should be cautioned [illegible]eplace the caps on the jackboxes.

Emergency breakaway of the probe fueling unit is the same as for a normal rig disconnect, unless complications arise. The following describes both methods of disconnecting the probe. After completion of fuel transfer, remove the remating line and actuate the manual release lever (fig. 4-7) to release the probe. The delivery ship retrieves the fuel hose. After the hose has been fully retrieved and the span wire has been detensioned, trip the pelican hook and ease the span wire over the side of the receiving ship with an easing-out line.

CAUTION: Release of the span wire prior to retrieval of the hose can result in damage to the fueling probe; therefore, the span wire shall not be released until ordered by the delivery ship.

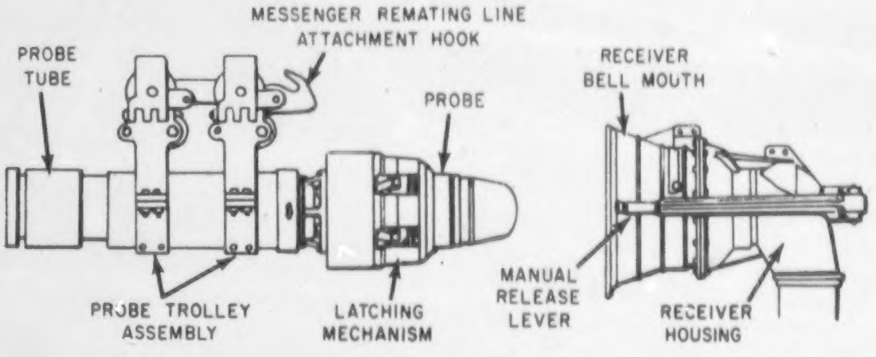

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Figure 4-7.—Single probe and receiver.

Line tension supplied by the ram tensioner in a tensioned span-wire rig must be removed prior to tripping the pelican hook which releases the span wire.

If the receiving ship cannot quickly disconnect the probe from the receiver, the delivery ship can do so by taking a strain on the retrieving line saddle whip, provided a stress wire connects the outboard saddle with the probe trolley. A line pull of 2,500 pounds is required to disengage the probe by this method.

All necessary tools, spare parts, and spare components necessary to effect repairs to transfer stations must be maintained in readiness to meet major or minor repair requirements. While individual ship configuration will dictate stowage of spare components, a complete set of tools and repair equipment must be maintained in a location readily accessible to transfer station personnel. Such tools and equipment should be inventoried and checked for proper operation prior to each fuel replenishment. Each transfer station should maintain, as a part of station equipment, a listing of all items (tools, spares, etc.) which may be required to repair the station, together with the stowage location of such items.

SETTLING AND STRIPPING

The stowage period between receipt of JP-5 on board and delivery to an embarked aircraft is a vital link in the cleaning process required. This settling period, in addition to proper stripping, will also take the load off the other cleaning processes in the system. Therefore, it is extremely important for fuel handlers to be familiar with the settling and stripping procedures aboard aircraft carriers.

SETTLING PERIOD

Use settling to the maximum degree possible to separate solids and water from fuel. The settling time for JP-5 is 3 hours per foot of product height. In order to obtain the maximum settling time for JP-5 tanks, the following operating procedures should be followed:

1. NEVER transfer JP-5 into an IN USE service tank.
2. Completely empty the in use service tank before taking suction on another service tank.
3. Avoid agitating settled tanks by minimizing the transfer of JP-5 to consolidate the fuel load or to correct the list or trim of the ship. This can best be prevented by following the proper emptying sequence and by taking suction from an equal number of port and starboard tanks simultaneously when transferring during normal operations.
4. Coordinate the replenishment date so that there is always enough JP-5 on board to top off all service tanks prior to receiving JP-5 aboard.

5. When transferring JP-5 from stowage to service tanks, the tank emptying sequence for any nest of tanks should be shceduled so as to empty the overflow tanks first; the slack tanks, if any, next; and the tanks that have had the longest settling time last.

Rotate the tank emptying sequence between the different nests of tanks so that all tanks are utilized and not just those that are most convenient to the pumproom operator. The tank emptying sequence will be coordinated with damage control central.

STRIPPING SCHEDULE

Serious contamination of JP-5 has occurred on several aircraft carriers, resulting in the loss of untold millions of dollars in equipment (aircraft) and, in some instances, loss of human life. All of this could have been avoided if **WATER** and **SOLIDS** in the fuel had not been allowed to reach the aircraft fuel cells.

This useless waste was caused in the most part by improper use of the equipment, a lack of understanding of the need for stripping, and in some cases a complete disregard of the stripping equipment and procedure. Therefore, it is imperative that the following stripping schedule and procedure be complied with.

Strip the stowage tanks with the motor-driven stripping pumps as follows:

1. Prior to receipt (in the same manner previously described).
2. The day after receiving JP-5 aboard.
3. Weekly thereafter as applicable.
4. The day before transferring to service tanks (if time permits).
5. Immediately prior to transferring JP-5 from stowage to service tanks.

Strip the service tanks with the hand-operated stripping pumps as follows:

1. Before filling.

2. After filling (allow for settling).

3. Just prior to fueling aircraft (each and every time).

CAUTION: Never strip the service tanks in port with the hand-operated stripping pump.

During nonoperational periods, when the ship is cruising at sea and no flight operations are scheduled, strip the service tanks daily. In port or at sea, strip stowage tanks weekly.

STRIPPING PROCEDURE

Before any transfer operation, the JP-5 stowage tanks concerned must be stripped of all water and sludge by using the motor-driven stripping system.

The stripping system is alined in basically the same manner as described for stripping ballast tanks except that the discharge is directed to the contaminated JP-5 settling tank.

Inform the damage control watch officer of the intended operation, the number of tanks to be stripped, and the number of the settling tank designated to receive the stripped liquids. Then proceed as follows:

1. Open the valve on the single-valved stripping manifold to the tank to be stripped.
2. Open the valve on the flood and drain manifold leading to the stripping main.

NOTE: Step 2 is necessary only for tanks that are designated JP-5 or ballast.

3. Open the necessary valves in the stripping main leading to the suction header of the stripping pump.
4. Open the stripping pump inlet valve.
5. Open the stripping pump discharge valve.
6. Open the cutout valve from the discharge header leading to the contaminated JP-5 settling tank.
7. Start the motor-driven stripping pump.
8. Open the test connection on the discharge side of the stripping pump.

Take frequent samples of the JP-5 being discharged. When a sample of clean, bright, water-free JP-5 is obtained, the tank is stripped. Close the valve on the single-valved stripping manifold, and open the valve to the next tank to be stripped. Strip all tanks in the same manner.

CAUTION: The clean JP-5 remaining in the system between the single-valved stripping manifold and the stripping pump from the previously stripped tank MUST be discharged past the test connection before a conclusive sample can be obtained from the next tank to be stripped.

This can be accomplished by having a general knowledge of the capacity of the stripping system piping between the two points and the capacity of the stripping pump. Run the pump accordingly. Allow extra running time for a safety factor.

EXAMPLE: Pipe Capacity–160 gallons
Pump capacity–50 gpm

Run pump 4 minutes before taking sample of next tank.

When all stowage tanks have been stripped, stop the pumps and close all valves in the system. Notify damage control central of the capacity of the contaminated settling tank.

The service tanks can be stripped in basically the same manner as the stowage tanks by using the motor-driven stripping pumps. However, this should rarely, if ever, be necessary except when completely emptying the service tanks (the last 24 inches of fuel) prior to maintenance, cleaning, etc., and to remove the wash water after a cleaning operation.

If the stowage tanks are allowed adequate settling time and are properly stripped, and if the transfer filters or centrifugal purifier are maintained and operated properly, there should NEVER be enough water in a service tank to necessitate using the motor-driven stripping system for this purpose.

Service tanks are normally stripped by use of the hand-operated stripping pump. The procedure used is as follows:

1. Open the valve on the suction side of the stripping pump leading to the service tank to be stripped.
2. Open the valve on the discharge side of the stripping pump.
3. Operate the pump handle (back and forth in a 90° arc) until clean fuel is observed in the discharge line (as indicated by the bull's-eye sight gage).
4. Open the test connection and take frequent samples. Pump until a sample of clean, bright, water-free JP-5 is obtained.

NOTE: The hand pump is capable of discharging 30 gpm at 50 double strokes per minute.

When stripping service tanks with the hand-operated stripping pump prior to filling, empty the transfer filtering media drain box before securing the system.

NOTE: The drain box can be emptied through connections off the motor-driven stripping system on some ships.

TRANSFER SYSTEM OPERATIONS

Transferring JP-5 internally is accomplished by the three individual transfer pumps in each of the forward and after pumprooms. When transferring from stowage to service tanks, use the following procedure:

1. Strip all tanks concerned, both stowage and service.
2. Empty the transfer filter drain box (as applicable).
3. Arrange the tank emptying sequence with damage control central. Empty the overflow tank first, the slack tanks second, and the tanks that have had the longest settling time last.
4. Open the following valves:
    a. Tankside manifold valve to one port and one starboard tank.
    b. All transfer mainside manifold valves for all tanks to be emptied.

NOTE: Insure that the telltale valves are closed.

    c. All valves in the transfer main branch header between the manifolds and pump suction header.
    d. Valves in the suction header.
    e. The pump inlet and discharge valves to ONE pump.
    f. All valves from the pump discharge header to ONE purifier.

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g. The service tank cutout valve to the tank to be filled.

5. Connect the seal water inlet hose to the plug valve on the purifier and open the supply valve.

NOTE: Preoperational checks required on purifiers, before starting, are described in detail in chapter 8 of this training manual.

6. Start the purifier.

7. If the purifier bowl shell assembly is clean and attains 4100 rpm (146 to 150 bumps per minute within 3 minutes), open the seal water plug valve on the purifier (4100 rpm's in 8 minutes on direct drive purifiers).

NOTE: To minimize vibration when starting with a dirty bowl, admit seal water immediately after pressing the start button.

8. Open the main water-discharge observation port on the cover assembly. When water discharges past this port, close the seal water inlet plug valve on the purifier and at the supply end.

9. Start the transfer pumps.

10. When the pump discharge pressure builds up, simultaneously and SLOWLY open the following valves:

a. Purifier inlet globe valve and throttle to maintain 9 psi inlet pressure.
b. Purifier discharge globe valve and throttle to maintain 30 psi back pressure (±5 psi).

11. Log the time the transfer pump and purifier were started.

12. While the system is in operation, make the following additional log entries:

a. Transfer pump inlet and discharge pressure.
b. Purifier inlet and discharge pressure.
c. Purifier inlet temperature.

13. Take inlet and discharge samples.
  a. Analyze the samples with the AEL Contaminated Fuel Detector Mk III and the AEL Water Detector Kit Mk I.
  b. Log the results of the analysis.

NOTE: It is advisable to take a visual sample of the contents of the stowage tank from which suction is being taken at the initial opening of the manifold valves. This sample can be drawn through the telltale valve.

14. If the transfer pumps lose suction before the service tank is full, take the following action:

a. Close the purifier inlet and discharge valves.
b. Close the manifold valves to the empty tanks.
c. Place additional tanks on the line.
d. When the transfer pump discharge pressure is again attained, repeat step 10.

NOTE: As an added safety factor, an overboard discharge observer should be posted during this operation.

15. When the service tank is 95 percent full, secure the system. The procedure for stopping the purifier is as follows:

a. Close the purifier inlet globe valve.
b. Stop the transfer pump.
c. Stop the purifier by pressing the stop button.
d. DO NOT engage the brake; the purifier will coast to a stop in approximately 70 minutes.
e. As the purifier slows down, centrifugal force diminishes, and inlet and discharge pressure will drop to zero.
f. When the flapper in the discharge sight flow gage stops, close the globe valve in the purifier discharge line.
g. Close all valves in the filling and transfer system.
h. Make the following log entries:
  (1) Time transfer pump stopped.
  (2) Time purifier stopped.
  (3) Gross gallonage removed from stowage tank.
  (4) Net gallons received in service tanks.

During the transfer operation, samples for visual examination must be taken from the purifier outlet at regular intervals in accordance with local instructions. Samples must be clean and bright and contain NO free water. A cloud, haze, specks of sediment, or entrained water indicates the fuel is probably unsuitable and points to a breakdown in the purification process. Should this occur, the transfer operation must be secured until stowage tanks concerned have been restripped; a clean, bright, water-free sample is received on the discharge side of the stripping pump; and the centrifugal purifier is inspected and discrepancies are corrected.

TRANSFERRING FROM STOWAGE TO STOWAGE

This operation should rarely be necessary if an emptying sequence was properly established and followed (except when consolidating the fuel load prior to receiving). If and when this operation is called for, it will, in most instances, require transferring JP-5 from port to starboard, or vise versa, to correct the list on the ship; or transferring JP-5 from forward to aft, or vice versa, to correct the trim on the ship.

The operating procedure for this operation is basically the same as transferring from stowage to service with the following exceptions:

1. Filtering equipment and sampling procedures are not required.
2. The transfer piping from the discharge header of the transfer pumps is alined to discharge into the opposite transfer main branch header, from which suction is being taken (when transferring from port to starboard, or vice versa); or to the transfer main (when transferring from forward to aft, or vice versa).

CAUTION: The overflow tank for any nest of tanks scheduled to receive fuel must be empty before JP-5 can be transferred into any tank in that nest.

CONSOLIDATING FUEL

When any transfer operation has been completed, consolidate to the greatest extent possible the last 24 inches of JP-5 remaining in the stowage tanks. (As much as 5,000 gallons remain in some of the larger tanks after the transfer pumps lose suction.) This consolidation must be accomplished by the motor-driven stripping pump.

The procedure for consolidating the last 24 inches of JP-5 is basically the same as that outlined for stripping, except for the following:

1. Permission is not required from damage control central, nor is assistance required of the engineering department, unless the amount of fuel being consolidated may affect the trim of the ship.
2. The stripping pump discharge header is alined to direct the discharged fuel into the transfer main instead of the contaminated fuel oil drain system or the contaminated JP-5 settling tank.

From the transfer main, the JP-5 is directed into preselected stowage tanks. Consolidated fuel should be allowed maximum settling time before it is stripped prior to use.

BALLASTING OPERATION

The empty ballast stowage tanks are ballasted (filled with sea water) to preserve the underwater protection system of the ship. Ballasting must be accomplished in accordance with current ship's ballasting instruction for each individual ship.

Tanks on CVA's are ballasted by gravity through the sea chest valve on the flood and drain manifold and the single-valved stripping manifold. On LPH's and LPD's this water is supplied from the ship's fire main system.

Ballasting procedure is as follows:

1. Follow the tank filling sequence as scheduled by damage control central to maintain the proper list and trim of the ship.

2. Open the valves on the single-valved stripping manifold to the tanks to be filled.

NOTE: ALL tanks that are served by one flood and drain manifold can be filled simultaneously.

CAUTION: Open an equal number of tanks on the opposite side of the ship.

3. Aline the valves on the flood and drain manifold for ballasting.
   - a. Unlock the sliding lock bar by loosening the two bolts over the oblong slots.
   - b. Position the lock bar so that the circular hole in the keyhole slot is directly above the raised collar on the sea chest valve stem.
   - c. Rebolt the lock bar in position.

4. Open the sea chest valve.
5. Sound the tanks to determine the instant they are full.

CAUTION: The static head tank liquid level ndicators cannot be used for this purpose, as they are designed for JP-5 and not sea water.

6. As each tank becomes full, as indicated by the tank sounding teams, close the valve on the single-valved stripping manifold.
7. When all tanks are ballasted, close the sea chest valve and reposition the lock bar.
8. Lock the tank side valve (on the double-valved filling and suction manifold) in the CLOSED position.
9. Open the telltale valves on the double-valved manifold and drain the contents; then close these valves.

CAUTION: Thereafter, as long as the tanks are ballasted with sea water, periodically open the telltale valves to determine the condition of the tank side valves and transfer main side valves.

NOTE: Most ballast tanks will not fill completely–some will only half fill due to tank height and draft of ship. Ballast liquid will seek its own level.

OFF-LOADING JP-5

Off-Loading From Service Tanks

When it is necessary to off-load JP-5, the service pumps are used as transfer pumps. JP-5 is discharged off the ship via the transfer main, downcomer, filling connection, and thence to a barge, tanker, or fuel farm.

Since the service pumps are utilized as transfer pumps for off-loading JP-5, the piping and valves in the filling and transfer system and the service system must be alined to enable the service pumps to take suction from, and discharge into, the same piping as the transfer pumps.

Assume, in this operation, that the entire fuel load is to be off-loaded, including the JP-5 in the service tanks. This being the case, empty the service tanks first, since no special preparations are required to take suction from these tanks with the service pumps.

Aline the piping and valves as follows:

1. Open the service tank suction cutout valve between the service tank and the service pump suction header.
2. Open the service pump inlet valve.
3. Unbolt and rotate the spectacle flange (or line blind) to the OPEN position in the cross-connecting piping between the service pump discharge header and the transfer pump discharge header. Unlock and open the gate valve in this same line.
4. Open the valve between the transfer pump discharge header and the transfer main.
5. Open the transfer main bulkhead cutout valves leading to the downcomer.
6. Open the gate valve at the base of the downcomer.
7. Open the gate valve at the filling connection.

When topside preparations have been made for off-loading fuel, start the service pumps.

NOTE: The pump recirculating line is not required for this operation because the pumps are running only during actual pumping operation.

When pump discharge pressure reaches 80 psi, SLOWLY open the globe valve on the discharge side of the pump. Throttle pumps to avoid cavitating and maintain a minimum of 35 psi back pressure for automatic operation of pump motor controllers.

The service pumps are now taking suction from a service tank and discharging overboard via the service pump discharge header, transfer pump discharge header, and transfer main, up through the downcomer, and out the filling connection.

Continue the pumping operation as outlined above until all service tanks have been emptied. Then secure the pumps and aline the system for emptying the stowage tanks.

NOTE: The remaining 24 inches of JP-5 in the service tank are consolidated into preselected stowage tanks by the motor-driven stripping pump.

Off-Loading From Stowage Tanks

The piping arrangement from the service pump discharge header to the filling connection at the refueling station remains the same.

Aline the piping from the suction header of the service pump to the stowage tanks as follows:

1. Unbolt and rotate the spectacle flange in the cross-connecting piping between the service pump suction header and the transfer pump suction header. Unlock and open the gate valve in this same line.
2. Open the transfer main side manifold valves for all tanks to be emptied.
3. Open the tank side manifold valves to an adequate number of port and starboard tanks–MINIMUM of four (two port and two starboard).

NOTE: The suction headers for the service pumps are 8-inch to 10-inch lines, and all filling and suction lines to stowage tanks are 5-inch lines. Therefore, an adequate number of tanks must be open at all times, or the service pumps will lose suction.

4. Open ALL valves in the transfer main branch headers leading to the suction header of the transfer pumps.
5. Start the service pump with the discharge globe valve closed. When the pump discharge pressure reaches 80 psi, SLOWLY open the discharge globe valve.

Continue pumping until all fuel has been off-loaded.

When off-loading fuel, a tank emptying sequence must be followed to maintain the proper list and trim on the ship.

JP-5 SERVICE SYSTEM OPERATIONS

The operations described here for the service system include (1) flushing the service system, (2) fueling aircraft, and (3) defueling aircraft.

In order to give a more complete coverage including all the piping, valves, and component parts of the entire system (previously described in chapter 3), a system utilizing Blackmer service stations was chosen to be described here. The minor differences encountered on ships with Cla-Val service stations may be noted in the latter part of this chapter. (As the piping and valve arrangement for the various operations is described, refer to figure 3-25 in chapter 3.)

FLUSHING OPERATION

Prior to fueling any aircraft, the entire JP-5 service system must be thoroughly flushed after any one of the following occurrences:

1. After a shipyard overhaul (includes newly constructed or reconverted carriers).
2. After any major repair work has been accomplished on the JP-5 service system.
3. After drainback for an extended in-port period or for maintenance.

The flushing operation is performed to rid the piping of the large quantity of solids and condensation that accumulate during the installation of and/or repairs to the system during a shipyard overhaul.

Flushing also removes loose deposits of microbiological growth that can grow anywhere in the system where pockets of water exist.

Operation of the service system requires pumping large quantities of fuel at high pressure; therefore, every possible safety precaution must be adhered to.

Before operating this system (or, for that matter, any JP-5 pumping system), check the following equipment:

1. Ventilation. Insure that adequate ventilation is available in pumprooms, filter rooms, and other enclosed areas where personnel are stationed or fuel is handled.

2. Fire extinguishing equipment. Insure that all CO_2 bottles have been recently weighed and properly tagged, that the lead seals are intact, and that nothing is stowed that could interfere with the proper operation of the equipment.

3. Communications. Immediately establish communications over the 4JG circuit with the following:
   - a. Flight deck control.
   - b. Filter rooms.
   - c. Service stations on the hangar and gallery decks.
   - d. Manifold spaces, as necessary.

CAUTION: Inspect the telephone headsets. Insure that they are always in proper working order. Communications is a vital link in safe and efficient operation of any fuels handling operation.

The flushing operation is performed by pumping clean JP-5 through the service system piping from service to stowage tanks. It is best accomplished in a two-step operation.

Step one involves all the major piping, such as all service system piping in both the forward and after pumprooms, all quadrant distribution risers, and most of the outboard distribution mains.

Step two involves all service station risers, service stations, and aircraft refueling hose attached thereto.

The entire flushing operation can be accomplished with virtually no loss to the JP-5 fuel involved. However, it must be pointed out that being pennywise and dollar-foolish is a dangerous attitude. Do not sacrifice the lives of pilots and crew, or extremely expensive aircraft, to save a few dollars worth of fuel.

The piping and valve arrangement described here is for flushing the portside only, quadrants Nos. 2 and 4. The starboard side can be flushed in a similar manner. Pumping should be from forward to aft. All service tanks and service pumps must be utilized during the operation; however, no more than one of each should ever be used at any one time.

Step One of the Flushing Operation

Step one of the flushing operation is accomplished by pumping from the forward service tanks to the after stowage tanks.

CAUTION: The smoking lamp is OUT for ALL fueling operations.

1. Strip all service tanks with the hand-operated stripping pumps.

2. Insure the valves to all pressure gages and sight glass gages are open. These valves should remain open at all times, even when the system is secured. It will be necessary to close these valves only when maintenance, calibration, or replacement is required.

3. Aline the piping and valves in the forward pumproom as follows:
   - a. Open all cutout valves between all service tanks and service pumps.
   - b. Open the pump recirculating lines.
   - c. Aline the recirculating header to the first service tanks from which suction is to be taken.

4. Aline the distribution piping between the forward and after pumprooms via the outboard main, bypassing the pressure regulators and main fuel filters.

NOTE: Fuel pressure for the initial flushing operation is controlled by throttling the valve on the discharge side of the service pump.

CAUTION: Bypass the filters during the initial flushing operation to prevent unnecessary overloading of the filter elements, thus preventing premature rupture.

5. Aline the piping and valves in the after pumproom as follows:
   - a. Rotate the spectacle flange or line blind in the cross-connecting piping between the service and transfer pump discharge headers. Unlock and open the gate valve in this line.

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b. Open the valves from the transfer pump discharge header to the transfer main. From here it can be directed into empty stowage tanks in the after group.

The system is now alined for the initial flushing operation. Proceed as follows:

1. Close the valves in all service tank suction lines, EXCEPT the one leading to the service tank from which suction is to be taken.

NOTE: These valves were opened initially to flood the suction lines from each service tank to the service pump suction header.

2. Start one service pump; when a discharge pressure of 80 psi is reached, SLOWLY open the discharge valve. Throttle this valve to maintain a pressure which is high enough to prevent the service pump controllers from stopping the service pumps. This pressure should also be high enough to insure a high volume of flow throughout the system.

CAUTION: Before operating any service pumps, check for loose gear and proper lubrication, and turn the pump through by hand.

The flow of fuel is as follows: JP-5 is now flowing from the forward service tanks up through the distribution riser in quadrant No. 2 (bypassing the pressure regulator and service filter), outboard and aft through the crossover valves in the outboard distribution main and into quadrant No. 4. From here, the fuel is directed down through the distribution riser in quadrant No. 4 (bypassing the service filter and pressure regulator) into the service pump discharge header in the after pumproom. From this point, it passes through the cross-connecting piping to the transfer pump discharge header and thence to preselected stowage tanks in after groups via the filling and transfer system.

3. During the flushing operation, all the forward service pumps should be operated one at a time to insure cleanliness of all pump piping.

4. Thoroughly flush until a sample of clean, bright, water-free JP-5 is obtained, and analyze the sample using AEL detectors.

NOTE: A sample connection will have to be installed in the after service pump discharge header. Pressure gage or sight glass gage connections can be utilized for this purpose.

The system can be flushed from one service tank; however, each service tank suction line should be opened momentarily for flushing.

CAUTION: Make sure the recirculating header is alined to the service tank from which suction is being taken.

During the flushing operation, open all crossover lines for flushing.

After the initial piping arrangement has been flushed, stop the service pump and close all valves not required to complete step one.

Close the following valves in quadrant No. 4:

1. Filter bypass.
2. Fourth-deck riser.
3. Pressure regulator bypass.

The valve alinement in quadrant No. 2 remains the same.

To complete step one, it is necessary to flush only the service system piping in the after pumproom and the remainder of the outboard distribution mains (forward leg of quadrant No. 2, and the after leg of quadrant No. 4). These two operations are performed separately, but simultaneously.

The service system piping in the after pumproom is flushed through the cross-connection to the transfer pump discharge header as previously described.

Aline the piping and valves to take suction from the service tanks in the same manner as was outlined for the forward pumproom. Utilize all service pumps and service tanks one at a time during the flushing operation.

After the piping has been thoroughly flushed, stop the pump and close all valves in the after pumproom. Rotate the spectacle flange in the cross-connecting piping to the closed position (blank side in). Close the valve in the cross-connecting line and lock it in the closed position.

The remaining sections of the outboard distribution main of quadrants 2 and 4 are flushed through the venting connections at the most remote service stations, both forward and after.

The forward service pumps only will be utilized for this operation. The discharged fuel will be directed into the independent defueling main and thence into preselected stowage tanks.

Aline the system as follows:

1. Open the cutout valve in the after filter room leading to the after leg of quadrant No. 4.
2. Open the cutout valve in the forward filter room leading to the forward leg of quadrant No. 2.
3. Connect a section of hose to each venting connection, both forward and after.
4. Attach a pressure fueling nozzle to the venting hose.

NOTE: In order to facilitate using the pressure fueling nozzle for this and other flushing to follow, it will be necessary to adapt an aircraft type nozzle adapter to the defueling main. These adapters can be purchased through ASO or scavenged from "dud" aircraft.

5. Attach the pressure fueling nozzle to the defueling main.

CAUTION: Use proper grounding procedure.

6. Start one service pump in the same manner as previously described.

Flush until a clean, bright, water-free sample is obtained at the test connection on the pressure fueling nozzle and analyze the samples using AEL detectors. This completes step one of the flushing operation. Stop the service pump and close all valves in both quadrants 2 and 4.

CAUTION: In order to maintain the distribution system full of JP-5, close the service pump discharge globe valve before stopping the pump.

Close ALL valves opened for step one, except the pressure gage and sight glass gage valves.

NOTE: On ships that are equipped with a three-quadrant delivery of JP-5, quadrant No. 1 and JP-5 distribution piping located in quadrant No. 3 can be flushed in the same manner as prescribed above for the end legs of quadrants 2 and 4.

Step Two of the Flushing Operation

The piping arrangement and operating procedure between the pumproom and the service stations for step two of the flushing operation are practically identical as for fueling aircraft which is to follow. Therefore, in order to minimize repetition, the operation described here between the two points is for both operations.

The piping arrangement for one quadrant only is described here. Other quadrants can be alined in the same manner.

Upon entering the pumproom, establish communications and check for safety (ventilation, firefighting equipment, etc.). Inspect the pumps for loose gear and proper lubrication, and turn the pumps through by hand.

Set up the pumproom as follows:

1. Strip the in-use service tank.
2. Open the cutout valves in the suction line between the service pump and in-use service tank.
3. Aline the recirculating header to the service tank from which suction is to be taken.
4. Open the service pump recirculating line.

CAUTION: Insure that the service pump discharge valve is closed.

5. Aline distribution piping in the pumproom via the pressure regulating system; open the pressure regulator inlet and discharge valves; open the fourth-deck riser valve.
6. Aline the distribution piping in the filter room to activate the main fuel filter as follows:
   a. Open the filter inlet and discharge valves.
   b. Open the filter vent line.
   c. Aline the automatic water drain system.

d. Open both cutout valves leading to the forward and after legs of the outboard distribution main.

7. Aline the first service station to be flushed as follows:

a. Open the service station riser valve and the cutout valve between the service station and hose reel.

b. Unreel both fueling hoses and attach the pressure fueling nozzle from one hose to the defueling main.

CAUTION: Ground in proper sequence.

NOTE: The defueling main will have been alined to preselected stowage tanks as before.

8. Immediately prior to starting the service pump, open the pressure regulator and main fuel filter recirculating lines.

9. Start one service pump. When a discharge pressure of 80 psi is obtained, SLOWLY open the pump discharge globe valve. Observe the bull's eye sight glass gage in the filter vent. When a solid stream of JP-5 is discharging through this line, close the vent valves.

NOTE: Immediately upon putting a new filter on the line, observe and log the filter inlet, fallout, and discharge pressures.

CAUTION: Check the pressure setting on the pressure regulating system and make adjustments as necessary.

10. When the filter vent valve has been closed, start the Blackmer service station. Allow the service station to operate in the defuel position until all air and vapor have been eliminated.

11. Close nozzle toggle switch on the pressure fueling nozzle and place the service station in the fueling position by SLOWLY raising the operating handle on the 4-way valve.

Flush until a clean bright, water-free sample is obtained at the test connection on the pressure fueling nozzle. Analyze the sample using AEL detectors. Continue this operation on a station-by-station basis until each and every hose has been thoroughly flushed.

CAUTION: A minimum of 50 gallons must be pumped through each hose.

FUELING AND DEFUELING AIRCRAFT

The fueling of jet aircraft aboard carriers is handled by the AvFuels crew, under the direction of the aviation fuels officer. No one but a member of the AvFuels crew is to have anything to do with the fueling equipment. However, personnel other than the actual fueling crews are required in order to perform this operation in a safe and efficient manner. This should include the following:

1. Plane captain (squadron).
2. Electrician (squadron).
3. Anticontamination sentry (AvFuels division).
4. Fuel checker (AvFuels divison).

A fueling crew should consist of a minimum of three men, under the supervision of a crew leader. Their duties and responsibilities are as follows:

1. Nozzle operator—attaches the nozzle to the aircraft and operates the necessary valves and switches on the nozzle during the fueling operation, and assists in handling the hose.

2. Safety man—grounds the aircraft to deck metal, assists nozzle man in hookup, and stands by with CO_2 bottle and swab during the fueling operation.

3. Service station operator—operates service station on given signal from the nozzle man, assists in handling the fueling hose, and maintains communications with flight deck control.

The crew leader is responsible for the safe and efficient manner in which each crew member performs his assigned task. During flight operations, he must know the whereabouts of his assigned crew at all times. When directed by flight deck control, he assembles his crew at the designated aircraft. Prior to attaching the hose to the aircraft, the crew leader insures the following:

1. The plane captain is present.
2. All aircraft engines are stopped.
3. All electrical and electronic switches not required for the fueling operation are turned off.
4. A squadron electrician is available, if required, for the particular aircraft.

NOTE: On some jet aircraft it is necessary to have external power to operate the internal fuel transfer system.

The crew leader assists his crew in attaching the hose to the aircraft; but during the actual fueling operation, he should observe for safety and note any discrepancies encountered during the operation.

The plane captain mans the cockpit during the fueling operation to observe fuel quantity gages and operate necessary switches.

A roving fuel checker from the AvFuels division records the amount of fuel issued or defueled from each aircraft.

NOTE: Fuel is issued by the pound, not by the gallon.

Fueling Procedure

The following step-by-step fueling procedure must be adhered to and in the order listed:

1. Pressurize the service system, as previously described under step two of the flushing operation.

NOTE: Ships equipped with adapters for flushing the fueling hose into a selected stowage tank must flush out the hose for two minutes prior to refueling aircraft.

2. Unreel the hose and lead it out to the aircraft to be fueled.
3. Ground the aircraft to deck metal.
4. Ground the nozzle to the aircraft.
5. Remove the nozzle adapter cap from the aircraft.
6. Remove the dust cover from the pressure fueling nozzle.
7. Connect the pressure fueling nozzle to the aircraft.

CAUTION: Be absolutely sure that the nozzle is in the FULLY LOCKED-ON position prior to charging the hose with fuel.

8. Open the service station riser valve.
9. Open the cutout valve between the service station and the hose reel.
10. Start the Blackmer service station.
11. Allow the service station to run in the defuel position until all air and vapor have been eliminated.
12. Place the nozzle toggle switch in the ON position.
13. Place the 4-way valve in the fuel position by SLOWLY raising the operating handle.
14. Open the nozzle valve as applicable.

Fuel is now flowing into the aircraft. While the fuel is flowing, the anticontamination sentry obtains a sample at the pressure fueling nozzle for analysis in the AEL detection equipment or for laboratory analysis.

When the aircraft has received its proper fuel load, as indicated by the plane captain, secure the operation in the following manner:

1. Close the valve on the pressure fueling nozzle.
2. Place the nozzle toggle switch in the OFF position.

NOTE: When the ground circuit is broken, the Blackmer service station will automatically return to the defuel position and deflate the hose.

3. After the hose has completely collapsed, disconnect the nozzle from the aircraft.
4. Replace the nozzle adapter cap on the aircraft.
5. Replace the dust cover on the pressure fueling nozzle.
6. Remove the nozzle ground wire.
7. Remove the ground wire between the aircraft and deck metal.

Take the hose to the next aircraft to be refueled and repeat the same procedure.

After the last aircraft has been refueled, secure the system and stow all gear.

CAUTION: DO NOT DRAIN BACK the JP-5 service system.

In order to maintain the service system full of JP-5, secure the system in the following manner:

1. Stop the service station.
2. Close the filter recirculating line.
3. Close the pressure regulator recirculating line.
4. Close service pump discharge valve.
5. Stop the service pump.
6. Close ALL valves in the service system, except the pressure gage and sight glass gage valves.

No job is ever complete until all gear has been properly stowed. The care that the equipment is given is very important to future operation.

Sound-powered telephones should be properly made up and stowed in a dry space.

CO_2 bottles should be stowed in designated racks.

Swabs should be rinsed in water and aired in an exposed location.

Ground wire should be inspected and stowed in the proper space.

Defueling Operations

Defueling of jet aircraft on carriers with Blackmer service stations is accomplished by use of an air motor-driven defueling pump. The defueled fuel is directed into the independent defueling main and thence to a preselected stowage tank via the filling and transfer main.

The same safety precautions outlined for fueling aircraft are adhered to when defueling. The procedure for defueling (underwing method) is as follows:

1. Ground the aircraft to deck metal.

2. Ground the defueling pump to deck metal.

3. Attach an airhose from the ship's low-pressure air supply to the inlet side of the air motor.

4. Connect a 1½-inch hard rubber hose from the discharge side of the defueling pump to the defueling main.

5. Connect a 1½-inch hard rubber hose, with pressure fueling nozzle attached, to the suction side of the defueling pump.

6. Ground the nozzle to the aircraft and attach the pressure fueling nozzle.

7. Open the suction and discharge valves on the defueling pump.

8. Open the valve on the pressure fueling nozzle.

9. Open the ship's low-pressure air supply valve to the defueling pump.

CAUTION: Air pressure should be between 70 and 110 psi (90 psi is ideal).

The defueling pump is now drawing JP-5 from the aircraft and discharging it into preselected stowage tanks via the defueling main and the filling and transfer system.

CAUTION: Before defueling any aircraft fuel tanks into the ship's stowage tanks, the type and condition of the fuel involved must first be determined. This can best be attained by drawing a sample from the low point drain of the aircraft's fuel cells. Fuel found to be contaminated with other petroleum products or chemical dyes must not be defueled back into the JP-5 system.

NOTE: The dye referred to here is the RED chemical dye used by maintenance personnel for determining internal fuel leaks in the aircraft. The amount required for the test is sufficient to contaminate a 20,000-gallon tank of JP-5.

The procedure and the equipment used for overwing defueling are practically identical to those for the underwing method, except for the type of fueling nozzle used. For overwing defueling, an overwing nozzle with a short section of hard rubber hose attached is utilized vice the pressure fueling nozzle.

Remove the rigid or flexible spout from the overwing nozzle and attach a short length of 1½-inch hard rubber hose. The metal fittings will be removed from the end of the hard rubber hose that is to be inserted into the aircraft fuel tanks. A V-shaped notch is cut in the end of the rubber hose to prevent a vacuum from forming when the hose is lowered to the bottom of the tank.

Operate the defuel pump as before.

Ground as before.

Upon completion of the defueling operation, close all valves and secure all gear.

OPERATIONS OF THE JP-5 SERVICE SYSTEM (CLA-VAL FUEL/DEFUEL VALVE)

The JP-5 service systems that have the Cla-Val fuel/defuel valve service stations are operated in much the same manner as those with the Blackmer service stations. The operational differences are covered below.

Flushing operation step one is practically the same as previously described, except for steps concerning the automatic pressure regulator, which are eliminated. (The Cla-Val fuel/defuel valve eliminates the need for an automatic pressure regulator in the JP-5 service system.)

Flushing operation step two is as follows:

1. Aline the system from the service tank in use to the aircraft service station, as in step two previously described (delete pressure regulator steps).
2. Open the Cla-Val fuel/defuel valve's supply valve at the service stations.
3. Open the angle globe valve (in the cooling and lubricating line from the service station riser to inlet of the service station defuel pump).
4. Open the service station defuel pump discharge valve.
5. Open the necessary valves in the defuel main to the filling and transfer system (transfer main).
6. Open the necessary valves in the filling and transfer system to an equal number of empty port and starboard stowage tanks.
7. Start the service pump as before.
8. When the filter vent valve is closed, start the service station defuel pump.

Fuel then flows from the in-use service tank, up through the quadrant distribution riser to the aircraft service station. This fuel then flows through the cooling and lubricating line to the service station defuel pump. The defuel pump then pumps this fuel into the defuel main. The defuel main directs this fuel into the preselected stowage tanks via the filling and transfer system.

Flushing of the hoses is accomplished as before; i.e., attaching each hose, one by one, to an aircraft nozzle adapter (fitted into the defuel main). Using proper grounding procedures and safety precautions, pump at least 50 gallons through each and every hose.

Fueling of aircraft with the Cla-Val fuel/defuel valve is accomplished in the same basic manner as for flushing the hoses, except that the nozzle is connected to the aircraft. The personnel involved for fueling aircraft are the same as previously described. Safety precautions, such as ventilation, smoking lamp, firefighting equipment, and grounding procedures, are the same as previously described.

Defueling of aircraft is accomplished by utilizing the Cla-Val fuel/defuel valve which is designated as a "Defuel Valve Only" for this purpose.

Aline the system as follows:

1. Open the defuel pump discharge valve to the defueling main.
2. Aline the defueling main to preselected stowage tanks, via the transfer main.
3. Unreel the 2½-inch hard rubber hose (CVA's) 1½-inch (LPH's and LPD's).
4. Grounding procedures and methods used in attaching and detaching the hose to the aircraft are as previously described.
5. After the nozzle is in the FULLY LOCKED-ON position, start the defueling pump.
6. When the defueling operation is completed and the hose detached, start the hose reel motor, engage the clutch, rereel the hose, and secure the system.

CHAPTER 5

GASOLINE SYSTEMS AFLOAT

DESCRIPTION OF THE HIGH-CAPACITY AVIATION GASOLINE SYSTEM

The high-capacity aviation gasoline system was designed to receive, stow, and dispense to aircraft, large quantities of highly volatile fuel (115/145) with the greatest possible safety and maximum efficiency. The original system has proven so effective that no major changes have been required in the design of its principle of operation since it was first introduced into the fleet nearly two decades ago. There have been changes however in the original installation (a reduction in the stowage and distribution capabilities) to provide for greater stowage and distribution of JP-5. These changes were covered in the history of the Aviation Fuel Systems in chapter 3 of this training manual.

With these changes came different variations of the original high-capacity system, each modified to meet the needs of the particular class ship in which installed, and are generally referred to in that manner, i.e., CVA, CVS, LPH, and LPD. However, regardless of the class ship, like the JP-5 systems, they too, are practically identical in all respects except for the number, capacity, and physical location of some of their component parts and the stowage and distribution capabilities of the individual ships.

Stowage is in reference to the number and capacity of saddle-type stowage tanks installed on the different class carriers.

A set of saddle type stowage tanks consists of three interconnected tanks (outer, inner, and drawoff). Except for the tanks on the CVA-41 class, U.S.S. Midway, Roosevelt, and Coral Sea (which consist only of an outer and drawoff tank), they are constructed identically on all ships.

Distribution capability is in reference to the number of quadrant distribution risers and the capacity of the aviation gasoline pumps installed on the individual ships.

CVS-class carriers have a two-quadrant delivery of AvGas—two quadrants on the starboard side.

ALL others, CVA's, LPH's, and LPD's, have only a one-quadrant delivery of AvGas—located on the starboard side in the same vicinity (in respect to forward or aft) as their stowage tanks.

There are two aviation gasoline pumps for each quadrant distribution riser. Normally, the size of the quadrant distribution riser is in relation to the capacity of the quadrant, i.e., 6 inches, 1,200 gpm; 8 inches, 2,000 gpm. However, with the introduction of the high-capacity system this does not hold true.

Regardless of the number of tanks, pumps, and quadrant distribution risers, all high-capacity gasoline systems are operated identically.

SEA WATER SYSTEM

There is one sea water pump for each aviation gasoline pump installed in the pumproom. The sea water pumps are used to pressurize the aviation gasoline tanks to force aviation gasoline up to the inlet side of the AvGas pumps with an adequate positive pressure. One sea water pump must be in operation for each aviation gasoline pump to be used.

Except for the number of sea water pumps on the CVS class carrier (which has four, vice two for all other ships) and the additional outer tank supply riser for those ships equipped with two sets of stowage tanks, the arrangement of the sea water piping and valves is identical on all ships regardless of class. Refer to figure 3-2 (B) in chapter 3 for the sea water piping arrangement on a CVS.

AVGAS SYSTEM

The arrangement of the aviation gasoline piping and the valves and component parts such as pumps, pressure regulators, flowmeters, etc., are also practically identical, regardless of the class ship. They differ only on the CVS (which again has four AvGas pumps vice two for all other ships) and in the number, location, and capacity of the main service filters.

The CVA-43 and all CVA-63 class carriers and up have two 880-gpm vertical filters located in the filter room on the 3rd deck level. The size, shape, and number of filters will vary from ship to ship. On ships having two filters installed, one filter is designated as "IN-USE" and the other as "STAND-BY". LPD's have two 400-gpm vertical filters located at the pumproom level. The LPH's have one 300-gpm vertical filter installed at each service station. All other CVA's and CVS's have one main service filter located in the filter room at the 3rd deck level. Their capacity is in relation to size of the distribution riser on the individual ships, as previously described.

A typical CVA high-capacity aviation gasoline system is described in this chapter. It is the most representative of the majority of the systems presently in use in the fleet.

Each component of the system except those previously covered in other chapters of this training manual, is described in detail.

Since pipe sizes will vary on the different class carriers (in relation to pump capacity) and are immaterial in the operation of the system, they are not discussed.

Due to the congested piping arrangement and in order to give a more detailed description, this system is described in three separate sections–tanks, sea water piping and valves, and the AvGas piping and valves.

Stowage Tanks

The "saddle" type stowage tanks are designed to provide the greatest possible safety for the stowage of aviation gasoline. They are located inboard on or near the centerline of the ship. The top of the tank is just below the first platform (5th deck) and the bottom is the hull of the ship.

A set of stowage tanks (fig. 5-1) consists of three tanks–an outer tank, an inner tank, and a drawoff tank. The outer tank encloses the inner tank and the inner tank encloses the drawoff tank from which the aviation gasoline pumps are supplied. The stowage tanks are surrounded by cofferdams filled with nitrogen for protection against fire and explosion hazards.

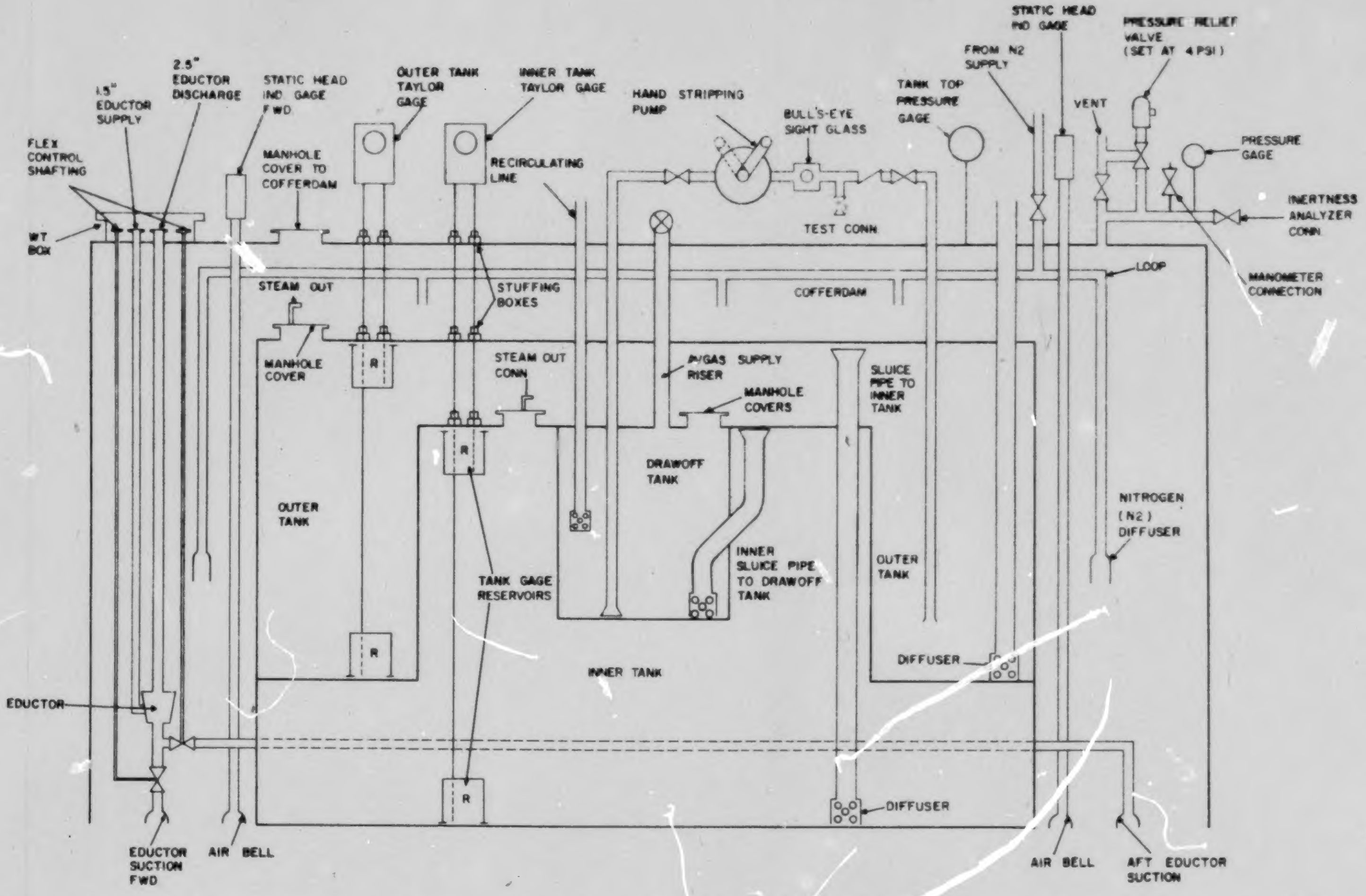
A manhole cover is provided in the top of each tank for gaining access for cleaning, maintenance, etc. A Buna-N-Cork gasket is installed between the tank and manhole cover plate to prevent leakage. The outer tank manhole cover plate is fitted with a steam out connection.

OUTER TANK.–The sea water supply riser enters the outer tank at the top and terminates in a diffuser near the bottom. The sea water required for pressurizing the tanks is discharged through this line.

A pressure gage line extends from the top of the outer tank to a pressure gage located in the pumproom. The gage has a red pointer, indicating the maximum allowable tank top pressure for that set of tanks. (Allowable pressures will vary for the different class ships.) A warning plate attached near each gage reads: THE MAXIMUM ALLOWABLE TANK TOP PRESSURE INDICATED BY THE FIXED RED POINTER SHALL NOT BE EXCEEDED WHEN FUELING THE SHIP. The gage is corrected to allow for the difference in height between the tank top and gage.

Two in-tank reservoirs (sump tanks) for Taylor gages are installed in the outer tank. One reservoir is installed at the top of the tank and the other at the bottom directly underneath the upper. Stuffing boxes are provided where the tubing for the Taylor gage passes up through the outer tank. The stuffing boxes prevent leakage of AvGas and sea water out of the tank and nitrogen in the cofferdam from entering the tanks.

The outer tank is interconnected with the inner tank by a sluice pipe. The sluice pipe extends from near the top of the outer tank and


FLEX CONTROL SHAFTING
WT BOX
1.5" EDUCTOR SUPPLY
2.5" EDUCTOR DISCHARGE
STATIC HEAD IND GAGE FWD
MANHOLE COVER TO COFFERDAM
OUTER TANK TAYLOR GAGE
INNER TANK TAYLOR GAGE
RECIRCULATING LINE
HAND STRIPPING PUMP
BULL'S-EYE SIGHT GLASS
TEST CONN
TANK TOP PRESSURE GAGE
FROM N2 SUPPLY
STATIC HEAD IND GAGE
VENT
PRESSURE RELIEF VALVE (SET AT 4 PSI)
PRESSURE GAGE
INERTNESS ANALYZER CONN
MANOMETER CONNECTION
LOOP
STEAM OUT
STUFFING BOXES
COFFERDAM
MANHOLE COVER
R
STEAM OUT CONN
AVGAS SUPPLY RISER
MANHOLE COVERS
SLUICE PIPE TO INNER TANK
DRAWOFF TANK
OUTER TANK
NITROGEN (N2) DIFFUSER
INNER SLUICE PIPE TO DRAWOFF TANK
OUTER TANK
TANK GAGE RESERVOIRS
INNER TANK
DIFFUSER
EDUCTOR
DIFFUSER
EDUCTOR SUCTION FWD
AIR BELL
AIR BELL
AFT EDUCTOR SUCTION

197.19.1

Figure 5-1.—Aviation gasoline stowage tanks.

terminates in a diffuser at the bottom of the inner tank. The top of the sluice pipes is flared to reduce friction. The outer tank completely envelopes the inner tank.

INNER TANK.–The inner tank has the largest capacity of the three tanks. It also contains two reservoirs and connecting tubing for the Taylor gages. The reservoirs are installed in exactly the same manner as those in the outer tank. The inner tanks are interconnected with the drawoff by a sluice pipe. The sluice pipe extends from near the top of the inner tank and terminates in a diffuser at the bottom of the drawoff. The inner tank completely envelopes the drawoff tank.

DRAWOFF TANK.–The drawoff tank is the smallest of three tanks. It is the tank from which gasoline is drawn when servicing aircraft, off-loading fuel, etc. It is the first tank to be filled when receiving fuel and the last tank to be emptied when off-loading fuel.

The AvGas supply riser extends from the extreme top of the drawoff tank to the common suction header of the AvGas pump.

The recirculating header terminates in a diffuser at midpoint in the drawoff tank.

The drawoff tank is provided with an independent stripping system to remove water and sludge from the bottom of the tank. This system is of the same hand operated type used with the JP-5 service tanks and has the same rated capacity (30 gpm at 50 double strokes per minute). The suction line is fitted with a shutoff valve and extends from three-fourths of an inch off the bottom of the tank. The discharge line, fitted with a bull's eye sight glass gage, test connection, one-way check valve, and a shutoff valve, terminates 24 inches off the bottom of the outer tank.

Cofferdams

The cofferdams provide a two-fold protection for the stowage tanks. Cofferdams are normally kept charged with nitrogen (N_2) gas to ½ psi at 50 percent inertness to reduce fire and explosion hazards. They also serve as a void space to collect any leakage from the stowage tanks.

The nitrogen supply line for purging and charging the cofferdams terminates in a loop which completely encircles the outer tank. From this loop (located near the top of the cofferdam) pipes (legs) extend down to near the bottom. Each leg is fitted with a diffuser which serves to spread the gas throughout the space. A stop valve for controlling the nitrogen entering the tank is located in the main supply line at the pumproom level.

An air escape riser, fitted with a shutoff valve, extends from the top of the cofferdam and vents to atmosphere at the hangar deck level. A bypass line is installed around the shutoff valve. This line contains a pressure relief valve (set at 4 psi), a manometer connection, pressure gage, and a portable inertness analyzer connection.

A fixed eductor is installed in each cofferdam to remove any sea water or aviation gasoline that might escape from the stowage tanks. The eductor is fitted with two suctions, one near the centerline at the forward end of the cofferdam and the other near the centerline at the after end of the cofferdam.

The controls for the eductor are located in a watertight box on the pumproom deck.

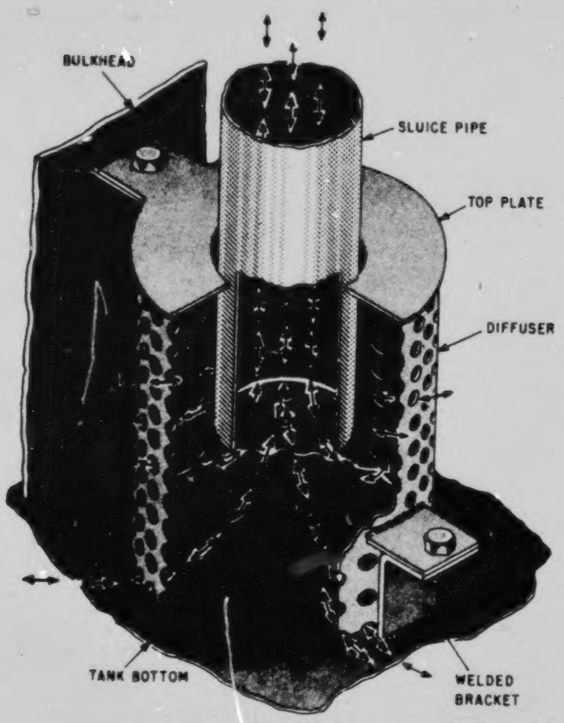
Two static head-type liquid level gages are installed in each cofferdam to indicate the presence of leakage into the compartment. These gages are the same as the three tube hand-pump model described in chapter 3 of this training manual. One gage is fitted on the centerline in the forward end of the cofferdam and the other on the centerline in the after end. This arrangement makes it possible to determine the presence of leakage, regardless of the trim of the ship.

Access to the cofferdam is gained through a bolted manhole cover in the pumproom deck. Normally the cofferdam manhole cover is located directly over the outer tank manhole cover.

Diffuser for Aviation Gasoline Stowage Tank

The diffuser reduces turbulence when aviation gasoline or sea water enters the stowage tanks. Diffusers are mounted on the bottoms of the aviation gasoline stowage tanks around the end of each sluice pipe and sea water supply riser. They are bolted to clips or brackets welded to the bottoms of the tanks and to the bulkheads. (See fig. 5-2.)

The diffuser is a perforated cylinder with an open bottom and has a top plate with an opening for the aviation gasoline or sea water supply pipe. The opening in the top plate is larger than the outside diameter of the supply pipe, permitting the pipe to move with the movement of the ship's structure. The total area of the perforations in the diffuser is five times that of the area of the supply pipe. Aviation gasoline or water enters the diffuser in a single stream and is broken into smaller streams as it passes through the holes in the cylinder. The distribution of flow over a large area reduces turbulence.


BULKHEAD
SLUICE PIPE
TOP PLATE
DIFFUSER
TANK BOTTOM
WELDED BRACKET

197.20

Figure 5-2.—Diffuser for AvGas stowage tanks.

Tank Gaging Equipment

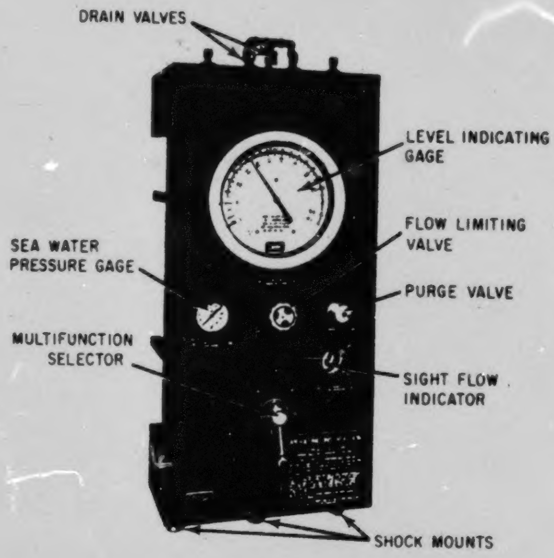
There are two different types of gages currently used in the aviation gasoline tanks to determine the amount of aviation gasoline within the tanks. These gages are the float actuated type and the water filled static head type gasoline gages.

The float actuated (liquidometer) gage is the older of the two and is gradually being phased out.

The water filled static head gage is installed on all new construction and reconversions. Only the water filled static head gage is discussed in this chapter. (See CLEAVAGE GAGE in chapter 5 of ABF 3 & 2 for a brief description of the float actuated gages.)

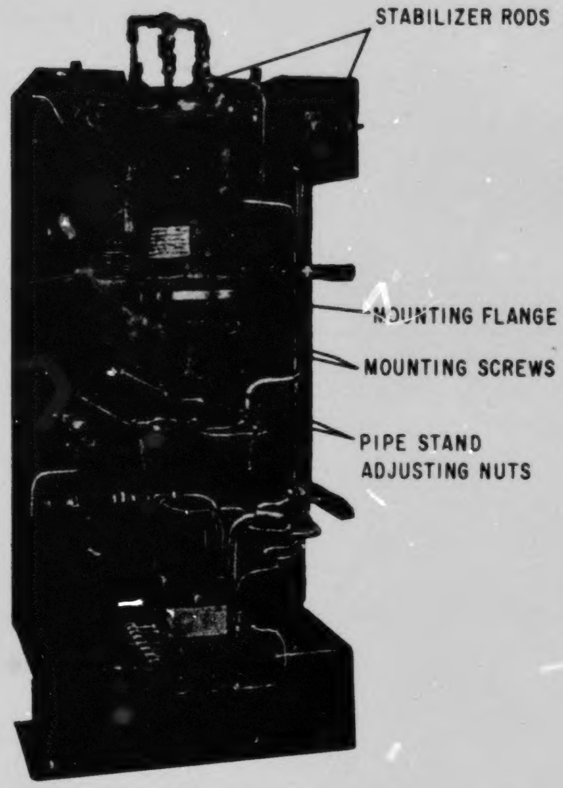
Water Filled Static Head Gasoline Gage

The water filled static head gasoline gage (figs. 5-3 and 5-4) is utilized to provide an accurate means of determining the amount of aviation gasoline in the saddle type stowage


DRAIN VALVES
LEVEL INDICATING GAGE
FLOW LIMITING VALVE
SEA WATER PRESSURE GAGE
PURGE VALVE
MULTIFUNCTION SELECTOR
SIGHT FLOW INDICATOR
SHOCK MOUNTS

198.30

Figure 5-3.—Level indicating panel for one tank indicating—front view.


STABILIZER RODS
MOUNTING FLANGE
MOUNTING SCREWS
PIPE STAND
ADJUSTING NUTS

198.31
Figure 5-4.–Level indicating panel for one tank indicating–rear view.

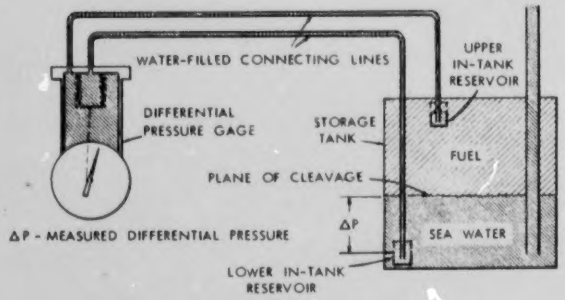
tanks. It accomplishes this task by sensing the differential created as the plane of cleavage between the two liquids (aviation gasoline and sea water) varies and converts this differential to gallons of aviation gasoline.

There are four components to this gage:

1. In-tank reservoir–an upper and lower reservoir for each of the inner and outer tanks (a total of four reservoirs).
2. A panel in the pumproom which contains:
    a. Differential pressure gage.
    b. Multifunction selector.
    c. Flow limiter valve.
    d. Sea water pressure gage.
    e. Purge valve.
    f. Flow indicator.
    g. Operating instructions.
3. Water-filled connecting lines connect the in-tank reservoirs to the gage panel.
4. Sea water supply for purging consists of:
    a. Fire main cutout valve.
    b. Strainer.
    c. Pressure-reducing valve.
    d. Pressure gage.
    e. Bypass purge line.
    f. Bypass purge valve.

The majority of the components are installed to facilitate purging the system. Only three items are necessary for the actual gaging of the tanks. These items shown in figure 5-5, are the differential pressure gage, water-filled connecting lines, and the upper and lower in-tank reservoirs.

When the stowage tanks are full (100%) of sea water, a constant differential pressure exists between the upper and lower in-tank reservoirs and the differential pressure gage reads ZERO. As the stowage tanks are filled with aviation gasoline, a varying differential pressure is developed between the upper and lower in-tank reservoirs. This varying differential pressure, created by the difference in specific gravities of the two liquids (AvGas and sea water), is transmitted to the gage panel via the water-filled connecting lines. The differential pressure gage senses this varying differential pressure and converts it to gallons of aviation gasoline present in the stowage tank.

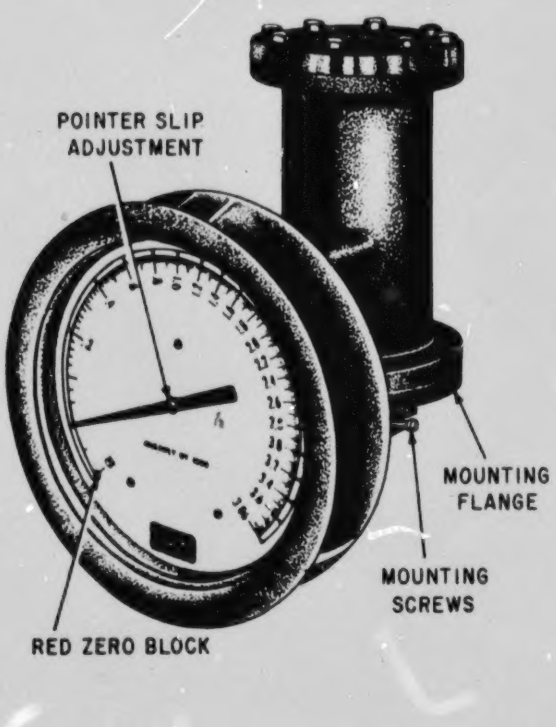

WATER-FILLED CONNECTING LINES
UPPER IN-TANK RESERVOIR
DIFFERENTIAL PRESSURE GAGE
STORAGE TANK
FUEL
PLANE OF CLEAVAGE
ΔP
SEA WATER
ΔP - MEASURED DIFFERENTIAL PRESSURE
LOWER IN-TANK RESERVOIR

198.32
Figure 5-5.–Schematic of interface level measurement.

A complete and independent water filled static head gasoline gage is installed for each inner and outer tank. Its advantage over the float activated gage is that there are no moving parts within the stowage tanks. All moving parts are in the pumproom; therefore, maintenance can be performed at any time.

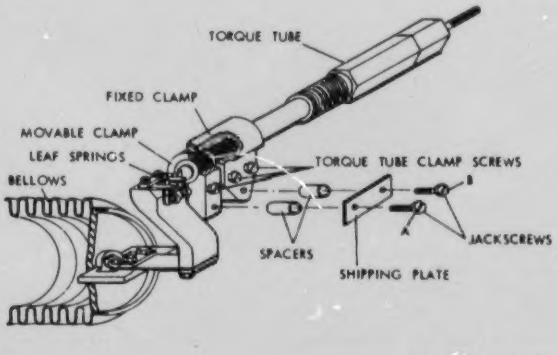
The differential pressure gage (fig. 5-6) measures the varying pressure differential from the tank and indicates its findings on a dial which is calibrated in gallons. This gage consists of three basic units—bellows, torque tube, and dial mechanism.

The bellows (fig. 5-7) is the pressure-sensitive element of the gage and is housed in the manometer body. The inside area of the bellows is connected to the lower in-tank reservoir. The outside area of the bellows is connected to the upper in-tank reservoir. (See fig. 5-8.) Pressure from the in-tank reservoirs will cause the bellows to expand or contract, depending on which area has the greater pressure.


POINTER SLIP ADJUSTMENT
MOUNTING FLANGE
MOUNTING SCREWS
RED ZERO BLOCK

198.33

Figure 5-6.—Differential pressure gage.

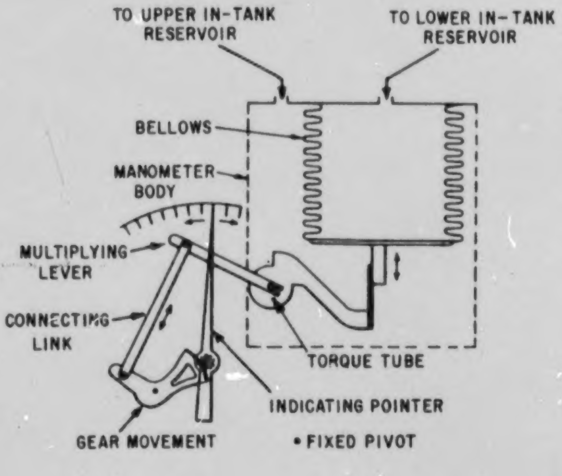

TORQUE TUBE
FIXED CLAMP
MOVABLE CLAMP
LEAF SPRINGS
BELLOWS
TORQUE TUBE CLAMP SCREWS
B
A
JACKSCREWS
SPACERS
SHIPPING PLATE

198.34

Figure 5-7.—Torque tube and shipping plate assembly.

The sealed base of the bellows is connected mechanically to a torque tube via leaf springs and a movable clamp. As the bellows moves, so moves the movable clamp.

An internal stop limits the contracting motion of the bellows. Three external stops


TO UPPER IN-TANK RESERVOIR
TO LOWER IN-TANK RESERVOIR
BELLOWS
MANOMETER BODY
MULTIPLYING LEVER
CONNECTING LINK
TORQUE TUBE
INDICATING POINTER
GEAR MOVEMENT
• FIXED PIVOT

198.35

Figure 5-8.—Schematic of operation.

limit the expanding motion of the bellows. These stops prevent damage to the bellows by limiting its travel.

Two vent valves are provided on the top of the manometer body to vent the bellows. One valve vents the inside area of the bellows and the other vents the outside area of the bellows.

The torque tube is the ballancing agent for the gage. It connects the bellows to the dial mechanism. One end of the torque tube is connected to the movable clamp and the other end connects a multiplying lever of the dial mechanism. The bellows end of the torque tube pivots through a fixed clamp.

Movement of the bellows causes the torque tube to rotate. This rotation is transmitted to the indicating pointer of the dial mechanism. (See fig. 5-8.)

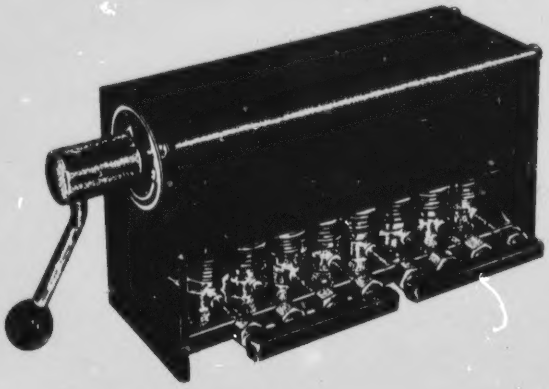
Before the panel is put into operation, a shipping plate, which is attached to the torque tube within the manometer body, must be removed. This plate and its two spacers are installed to prevent damage during shipment. (See fig. 5-7.)

Both the inner and outer tanks have their own gage. There is a torque tube for each gage. The torque tube is sized to give full-scale deflection when the tanks are full of aviation gasoline. The dial for the outer tank will read FULL when the stowage tanks are 95 percent full of aviation gasoline.

The multifunction selector consists of eight valve assemblies which are positioned in sequence by rotating a lever handle through five positions for purge and level indications. (See fig. 5-9.)

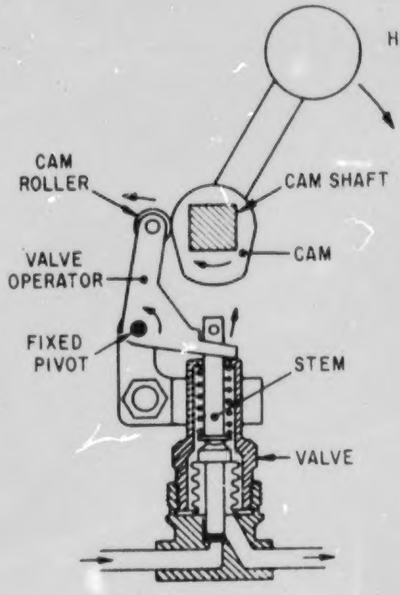
The selector is operated manually by rotating the handle in a clockwise direction, with the positions being OFF, 1, 2, 3, and 4. The valves in the selector are opened and closed by rotating cams secured on the instrument camshaft. (See fig. 5-10.)

The rise of each individual cam is positioned with respect to the others to provide the desired sequential action. (See fig. 5-11.) As the cam is rotated, its rise comes into position on the cam roller, causing the valve actuator to pivot upward, opening the valve. Further rotation of the rotating handle releases the valve, thereby allowing it to close.



198.36

Figure 5-9.–The multifunction selector.

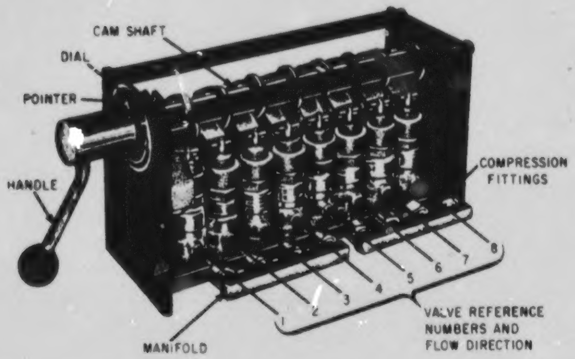


198.37

Figure 5-10.–Cam operated valves.

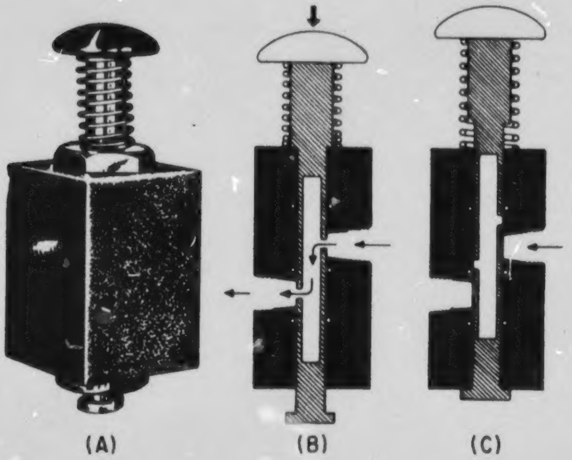
The valves are of the plug type using a sylphon type bellows for packing. Each valve is spring loaded to close.

The purge valve (fig. 5-12) is a two-way valve for on-off action only. The supply pressure may



198.38

Figure 5-11.—Multifunction selector without cover.



198.39

Figure 5-12.—Purge valve.

be piped into either connection, since pressure may be held from either direction because of the packing and porting design of the valve when it is in the closed position.

Flow through the valve is obtained by pushing the plunger knob in, thereby alining the supply port with the discharge, as shown in view B.

The valve is spring loaded to close. By releasing the knob, the spring causes the valve to close (view C).

The flow indicator (fig. 5-13) provides visual identification of the flow of sea water through a pipeline. The indicator has a hinged flapper suspended from the body so that it rests against the inlet passage at no flow. As liquid begins to flow, the flapper swings outward to a position generally proportional to the flow rate.

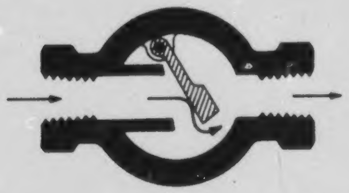
The in-tank reservoir connecting lines are gasoline-tight cylindrical tanks with a nontight flanged cover. They are open to liquid pressure near its top by two holes directly opposite each other. The in-tank reservoirs are brazed to the ends of connecting lines, one located near the top of the tank and the other located near the bottom of the same tank. Connecting lines terminate one-half inch off the bottom of the reservoir. The in-tank reservoirs are filled with sea water because of purging. The connecting lines are purged with sea water to prevent aviation gasoline from entering the pumproom through the lines.

The flow limiter is a globe type needle valve used to reduce sea water pressure to the desired pressure. It is located between the fire main supply and the purge valve.

The sea water pressure gage indicates the pressure of the sea water supply and is located between the flow limiter and the purge valve.

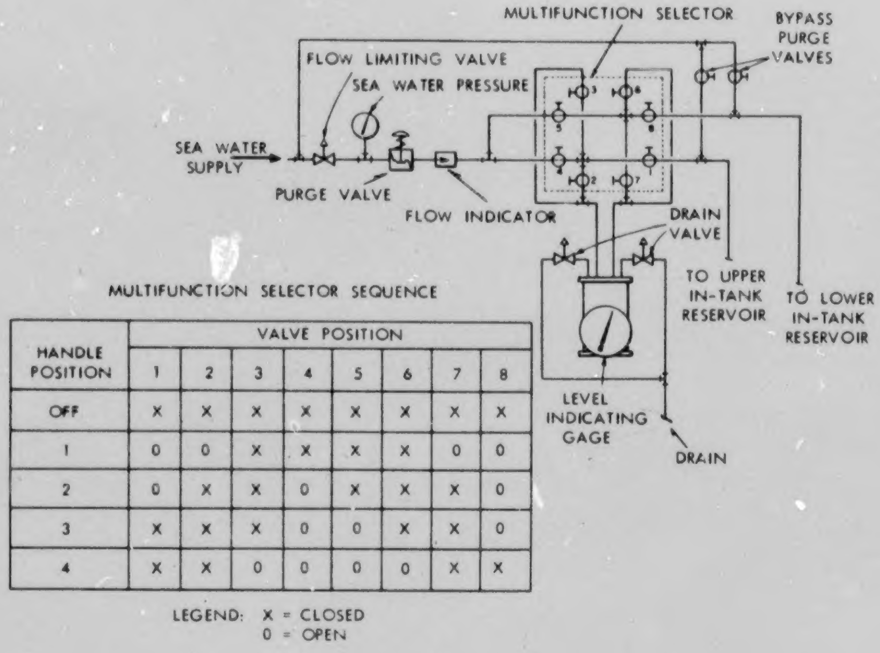
Operation. The stowage tank to be gaged must be full (aviation gasoline/sea water).

1. Set the multifunction selector handle to position number 2. (See fig. 5-14.)



198.40

Figure 5-13.—Flow indicator.


MULTIFUNCTION SELECTOR
BYPASS PURGE VALVES
FLOW LIMITING VALVE
SEA WATER PRESSURE
SEA WATER SUPPLY
PURGE VALVE
FLOW INDICATOR
DRAIN VALVE
TO UPPER IN-TANK RESERVOIR
TO LOWER IN-TANK RESERVOIR
LEVEL INDICATING GAGE
DRAIN
1
2
3
4
5
6
7
8

MULTIFUNCTION SELECTOR SEQUENCE

HANDLE POSITION	VALVE POSITION							
	1	2	3	4	5	6	7	8
OFF	X	X	X	X	X	X	X	X
1	0	0	X	X	X	X	0	0
2	0	X	X	0	X	X	X	0
3	X	X	X	0	0	X	X	0
4	X	X	0	0	0	0	X	X

LEGEND: X = CLOSED
0 = OPEN

198.41

Figure 5-14.—Schematic of systems valving arrangement.

2. The flow limiter should be set so that the flapper of the flow indicator is open to about three-fourths of its travel when the purge valve is depressed.
3. Depress the purge valve for 30 seconds to fill the connecting line and the upper in-tank reservoir with sea water.
4. Set the multifunction selector handle to position number 3.
5. Depress the purge valve for 30 seconds to fill the connecting lines and the lower in-tank reservoir with sea water.
6. Set the multifunction selector handle to position number 4. Then open the two vent valves on top of the bellows housing. The vent valves are opened ONLY at selector position number 4. Damage will occur to the bellows if opened in any other selector position.
7. Depress the purge valve for 1 minute. This purges air from both sides of the bellows and fills them with sea water.
8. Close the vent valves. With the purge valve and both vent valves closed, the gage pointer should fall within the red zero block. If the gage does not read zero at this point, the purge steps must be repeated.
9. Place the multiselector handle to the off position, then open the bypass purge valves for 1 full minute. This repurges the upper and lower in-tank reservoirs and connecting lines. Then close the bypass purge valves.
10. To read, place the multifunction selector handle to the number 1 position and observe the fuel quantity reading.

OPERATIONAL PROCEDURES.–The following operational procedures should be observed:

1. The system must be purged before the first reading.
2. The system must be purged once a week.

3. Once purged and set in operation, the selector handle can remain in position number 1 for continuous readings for periods up to one week.

MAINTENANCE.—Maintenance requirements for the gage are as follows:

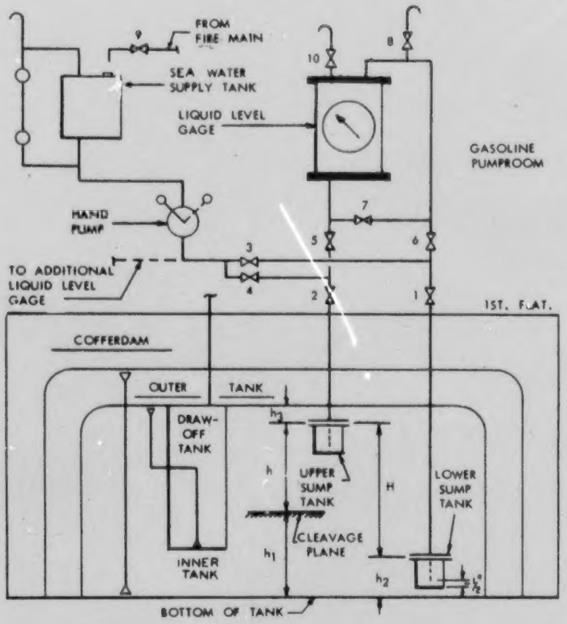
1. An indicating zero check is made daily by setting the multifunction selector handle to position number 4. The indicating gage should read zero. If it fails, repurge the system, recheck for zero and make pointer adjustment if necessary.
2. Do not oil or grease the gage. Lubricants may cause the gage to become sluggish or distort the gage reading.
3. Cleaning. Occasionally clean the sight glass in the flow indicator, using a laundry type detergent. Replace the neoprene gaskets if leakage occurs around the glass or the seals have been disturbed.
4. Purge Valve. Replace the O-ring if leakage occurs. No lubrication is necessary.
5. Multifunction Selector. No maintenance is necessary. If the selector fails, remove it from the panel and replace it with a new one.
6. Air Bubble Checkoff Selector Valves. Check each one of the eight valves, one at a time, by installing a hose to the inlet port. Immerse the free end of a hose in a bucket of water and apply air of 50 psi to discharge side of valves. Watch for bubbles to issue from the hose. If the valve leaks, replace it with a replacement valve. The directional arrow on the valve body will help to determine the inlet and discharge port of the valve.

Hand Pump and Sump Model

The gage discussed previously will eventually be installed on all carriers as funds become available. In the meantime, the less expensive hand pump and sump models are being installed.

The hand pump and sump model are basically the same as the multifunction selector type.

Sea water from the fire main is supplied to a sea water supply tank. (See fig. 5-15.) A hand pump is used to purge the system. Hand valves are used instead of the multifunction selector. There is no flow limiter, flow indicator, sea water pressure gage, or purge valve.



198.42
Figure 5-15.—Typical liquid level gage tank installation.

OPERATION.—The general procedure is to isolate the gage from the sump tanks and then purge the piping and sump tanks with sea water. Then vent and purge the gage and remaining piping to gage with sea water.

NOTE: All valves should be closed, except valve 7, before starting operations.

1. Open valve 9 and fill the sea water supply tank to the level in the upper sight glass.
2. Open valves 1 and 3 and purge the lower sump tank with a hand pump.
3. Close valves 1 and 3, open valves 2 and 4, and purge the upper sump tank with a hand pump.

4. Close valve 2, open valves 3, 5, 6, and 7, and vent valves 8 and 10. Operate the hand

pump until water flows out of vent valves 8 and 10.

5. Close valves 3, 4, 8, and 10, and open valves 1 and 2. Slowly close valve 7. The gage is now ready for use.

6. To find the amount of gasoline in the tank, read the gage and find the corresponding value from the conversion chart on the dial marking.

NOTE: Failure to vent and purge the system properly will result in erratic gage indicator movements.

SEA WATER PIPING AND VALVE ARRANGEMENT

Except for the previously mentioned differences, number of pumps in the CVS system (4 vice 2), and the additional outer tank sea water supply riser on ships having two sets of stowage tanks vice one, the sea water piping and valve arrangements are identical for all high-capacity aviation gasoline systems. (See fig. 5-16.)

Gate valves are installed throughout the sea water system. In describing the system they will be referred to as shutoff valves without reference to type.

Sea water is supplied directly from the sea, through a sea chest located in the cofferdam around the stowage tanks. A steel grating installed in the opening of the ship's bottom prevents large objects from being drawn into the system. Steam is used for cleaning out the sea chest in the event of clogging. Steam has a two-fold effect for cleaning purposes. It can be supplied at an adequate pressure for blowing out any debris and also provides a "cooking effect" as well. A shutoff valve is located between the sea chest and the sea chest supply riser. This valve is LOCKED OPEN. The controls for the sea chest shutoff valve and the steam out connection are located in the same watertight box as the controls for the cofferdam eductor.

The sea chest supply riser connects directly to the common suction header of the sea water pumps. An additional shutoff valve is installed in this line at the pumproom level.

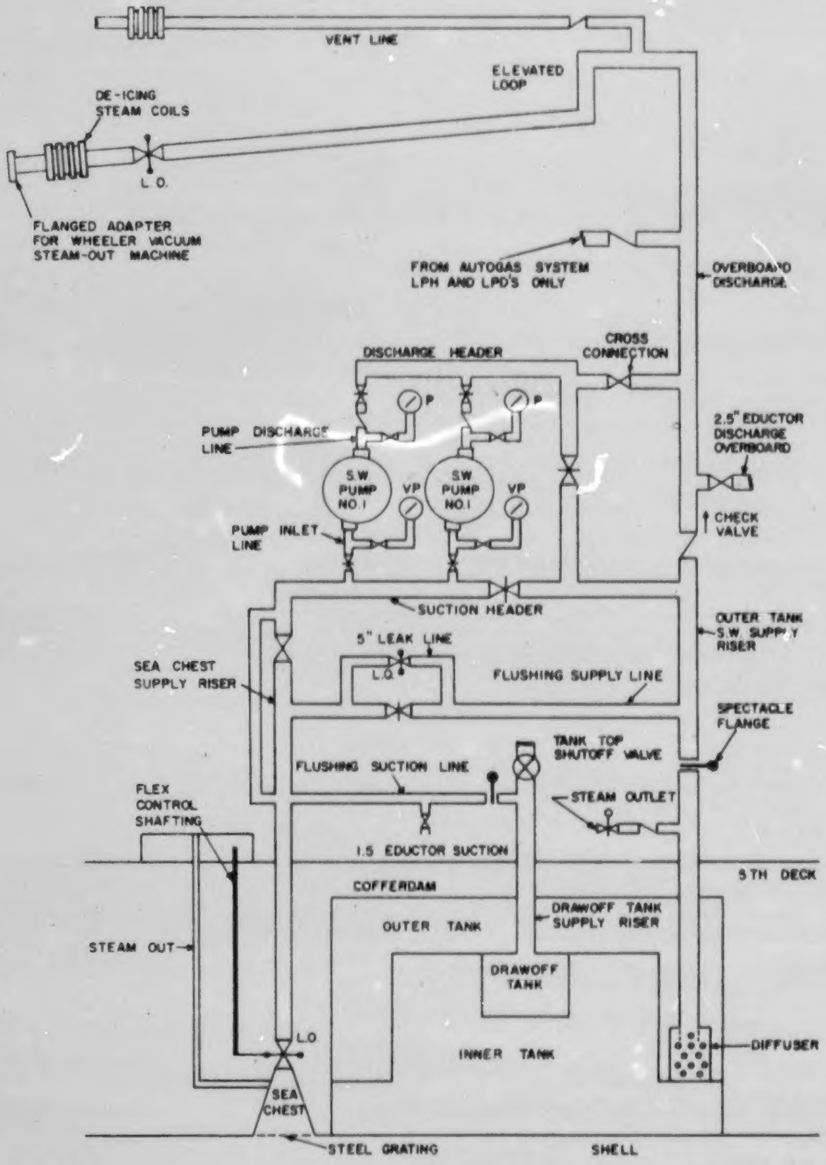
A shutoff valve is installed between the common suction header and the outer tank sea water supply riser. This valve is opened only when filling the tanks with sea water and when emptying the tanks of sea water.

The two motor-driven centrifugal sea water pumps are located in the AvGas pumproom, and the motors are in the adjacent pump motor room. The shafts connecting the pumps to their motor pass through a watertight stuffing box in the bulkhead. Both pumps take suction from the common suction header and discharge into a common discharge header. The pump suction line is fitted with a shutoff valve and a compound gage (VP). The discharge line contains a pressure gage (P), one-way check valve, and a shutoff valve. On centrifugal pumps, the pump inlet is always larger than the discharge line.

The common discharge header is connected to the outer tank sea water supply riser. The shutoff valve installed in this line is used to direct pump discharge pressure into the outer tank for pressurizing the system during normal operations.

The outer tank sea water supply riser terminates in a diffuser at the bottom of the outer tank. This line contains a spectacle flange (or pipe blind) and a steam out connection. The spectacle flange is rotated to the closed position when steam is injected either here or at the outer tank manhole cover for steaming tanks.

The one-way check valve separates the outer tank sea water supply riser and the overboard discharge line. The check valve and discharge line are normally larger than the riser, i.e., 10-inch riser 12-inch discharge, 12-inch riser 14-inch discharge, etc. The overboard discharge line is led upward in a loop and then overboard just above the third deck level. The height and size of the overflow loop acts as a relief device. It limits the pressure than can be exerted on the tanks (within the maximum allowable limits) when maximum pump capacity is discharged overboard. This would be the condition when the delivery of aviation gasoline is stopped and the sea water pumps continue to operate. However, the height of the loop also maintains an adequate back pressure on the tanks to force aviation gasoline to the suction side of the AvGas pumps, with a positive pressure (½ to 1 psi), when maximum delivery of AvGas is being made. A shutoff valve is installed near the end of


VENT LINE
ELEVATED LOOP
DE-ICING STEAM COILS
L.O.
FLANGED ADAPTER FOR WHEELER VACUUM STEAM-OUT MACHINE
FROM AUTOGAS SYSTEM LPH AND LPD'S ONLY
OVERBOARD DISCHARGE
CROSS CONNECTION
DISCHARGE HEADER
P
P
PUMP DISCHARGE LINE
2.5" EDUCTOR DISCHARGE OVERBOARD
S.W. PUMP NO.1
VP
S.W. PUMP NO.1
VP
CHECK VALVE
PUMP INLET LINE
SUCTION HEADER
OUTER TANK S.W. SUPPLY RISER
5" LEAK LINE
L.O.
SEA CHEST SUPPLY RISER
FLUSHING SUPPLY LINE
SPECTACLE FLANGE
TANK TOP SHUTOFF VALVE
FLUSHING SUCTION LINE
STEAM OUTLET
FLEX CONTROL SHAFTING
1.5 EDUCTOR SUCTION
5TH DECK
COFFERDAM
DRAWOFF TANK SUPPLY RISER
OUTER TANK
STEAM OUT
DRAWOFF TANK
L.O.
INNER TANK
DIFFUSER
SEA CHEST
STEEL GRATING
SHELL

198.43

Figure 5-16.—Sea water piping and valve arrangement.

the overflow line. This valve is "LOCKED OPEN." Steam heating coils are installed around the overflow line at the shell connection to keep the line clear during icing conditions. The extreme outboard end is equipped with a flanged adapter with portable protector ring for attaching a Wheeler vacuum steam out machine. (The Wheeler vacuum method of steaming tanks is performed only by shipyard personnel.)

A vent line, fitted with a one-way check valve, extends from the top of the loop to atmosphere just below the second deck level.

The vent line is provided to break syphoning effect of the overflow loop to prevent lowering the pressure at the aviation gasoline pump suction header. This line may also be equipped with steam heating coils.

A 2½-inch eductor discharge connection is installed in the overboard discharge line above the one-way check valve.

NOTE: The same overboard discharge line is used in both the high capacity aviation gasoline and auto gas systems on LPH and LPD class ships.

A cross-connection, fitted with a shutoff valve, is installed between the sea water pump common discharge header and the overboard discharge line. This line enables the pumps to discharge directly overboard when they are used for flushing or pumping out the stowage tanks.

Two additional lines are provided in the sea water system, primarily for flushing the stowage tanks. One line, fitted with a spectacle flange, extends from the common suction header to the aviation gasoline drawoff tank supply riser. The spectacle flange is kept in the closed position and is rotated to the open position only for flushing operations. This line is referred to as the FLUSHING SUCTION LINE. A connection is provided at the bottom of this line for attaching an eductor suction line.

The other line, fitted with a shutoff valve, extends from the sea chest supply riser to the outer tank supply riser. This line provides a source of water for the flushing operation and is referred to as the FLUSHING SUPPLY LINE. The shutoff valve is normally closed. Both lines, the flushing supply and flushing suction, are of the same dimensions as the sea water pump discharge line.

The shutoff valve in the flushing supply line is fitted with a ½-inch valved bypass line (leak line). The ½-inch valve is LOCKED OPEN. With the bypass line locked open, the stowage tanks are always open to the sea. Thus, the tanks will always remain full of liquid, subject to the ship's waterline head, regardless of contraction or expansion of the aviation gasoline due to temperature changes.

OPERATION OF SEA WATER SYSTEM

The sea water system serves to force the aviation gasoline through the tank and up to the aviation gasoline pump suction. A pressure of about ½ to 1 psi is required at the aviation gasoline pump suction to prevent the aviation gasoline pumps from becoming vapor locked.

The sea water pumps should be put into operation before starting up the aviation gasoline pumps. At least one sea water pump must be operating for each aviation gasoline pump to be put into operation. The sea water pumps will discharge to a saddle tank. As aviation gasoline is drawn from the stowage tank, it will automatically be replaced with sea water, thus maintaining a positive pressure on all aviation gasoline pump suctions. Excess sea water will automatically be discharged overboard through the overflow line.

To place the sea water system in operation, proceed as follows:

1. Line up the system to take suction from the sea and to discharge to the outer tank supply riser.
    a. Open the shutoff valve between the sea chest supply riser and the pump suction header.
    b. Open the shutoff valve between the pump discharge header and the outer tank supply riser.

2. Aline one sea water pump.
    a. Open the shutoff valve in the pump suction line.
    b. Vent the pump through a petcock at the top of the pump casing. When sea water appears, close the petcock.
    c. Start the pump with the discharge valve closed. When the pump discharge pressure builds up, open the discharge valve SLOWLY.

3. Cut in an additional sea water pump for each aviation gasoline pump to be placed in operation, to maintain a positive pressure at the AvGas pump suction header, using the same procedure outlined in step 2 above.

Operation of Cofferdam Fixed Eductor

Sea water, at fire main pressure, enters the eductor through the supply line and flows through the tapered nozzle. The nozzle converges the stream of sea water into a high-velocity jet which creates a partial vacuum as it passes through the throat of the eductor. The drainage water, rising to fill the vacuum, mixes with the high-velocity [illegible] of supply water and is forced up into the overboard discharge line. (See fig. 5-17.)

The eductor is provided with an inspection plate, which can be removed without disturbing the connecting pipe, to permit inspection of the interior or to renew the nozzle.

To use the eductor:

1. Connect 1½-inch firehose between the eductor supply and the fire main in the aviation gasoline pumproom.
2. Connect 2½-inch firehose between the eductor discharge valve and the hose valve on the elevated loop line in the aviation gasoline pumproom.
3. Open eductor discharge valve.
4. Open the hose valve on the elevated loop in the aviation fuel pumproom.
5. Open the hose valve on the water supply line in the aviation fuel pumproom.
6. Check that flow overboard has been established.
7. Open the forward suction valve to the eductor.
8. When the forward end of the cofferdam has been drained, close the forward suction valve and open the after suction valve.
9. When drainage has been completed, close all eductor suction valves.
10. Close the water supply and then the overboard discharge valves.
11. Disconnect and stow the eductor supply and discharge hoses.

Data for Cofferdam Eductor

Capacity	32 gpm
Suction Lift	15 feet
Discharge Head	55 feet
Actuating Water Required	40 gpm
Actuating Water Pressure	150 psi

A minimum of 80 psi fire main pressure is required to operate the eductors.

Portable Eductor

Portable eductors are used to provide drainage for aviation fuel pumprooms, to drain the sea water flushing lines prior to rotating the spectacle flanges, to remove condensate from piping during steaming out, and to drain the stowage tanks of the sea water that cannot be removed by the pumps. (See fig. 5-18.)

When not in use, the eductors are stowed as specified by the damage control officer.

The principle and procedure of operation of the portable eductor are similar to those of the cofferdam fixed eductor. The 1½-inch supply inlet on the eductor is connected to a 1½-inch firehose. The other end of the hose is connected to the hose valve on the fire main in the pumproom.

One end of the 2½-inch discharge hose is connected to the eductor; the other end of this hose is connected to the hose valve on the sea water overboard discharge pipe, also in the pumproom.

During operation of the eductor, open the discharge valve prior to opening the firemain inlet valve. At the end of the operation close the firemain valve first, then close the discharge valve.

AVIATION GASOLINE PIPING AND VALVE ARRANGEMENT

The similarity in stowage tanks and sea water piping for all high-capacity systems has been explained in the previous sections of this chapter. The same applies to the gasoline piping and valve arrangement. Except for previously noted differences (number and capacities of tanks, pumps, and filters) they are practically identical in all high-capacity systems.

There are three different type valves used in the large diameter piping. Some of the newer

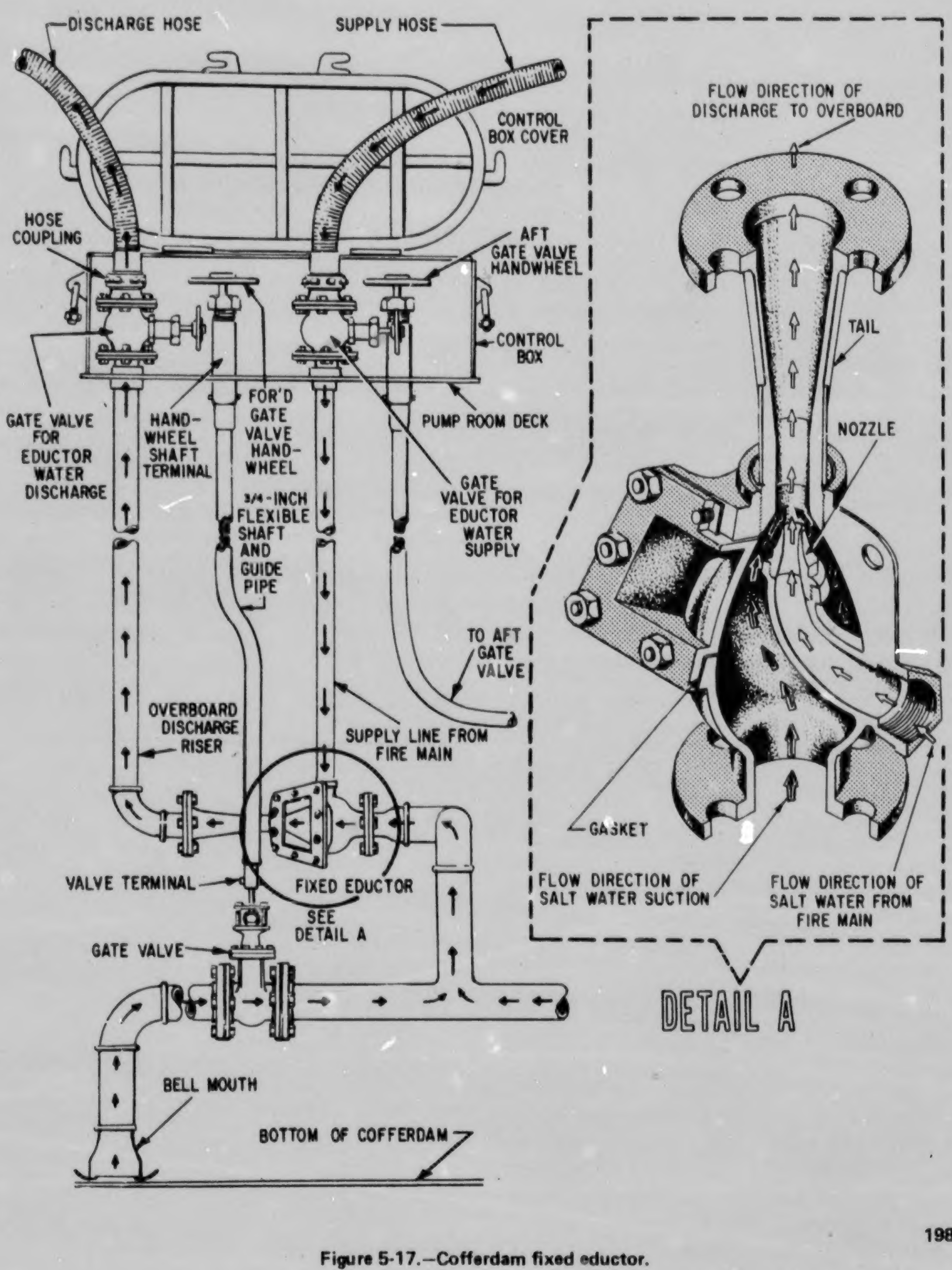

DISCHARGE HOSE
SUPPLY HOSE
CONTROL BOX COVER
HOSE COUPLING
AFT GATE VALVE HANDWHEEL
CONTROL BOX
PUMP ROOM DECK
GATE VALVE FOR EDUCTOR WATER DISCHARGE
HAND-WHEEL SHAFT TERMINAL
FOR'D GATE VALVE HAND-WHEEL
GATE VALVE FOR EDUCTOR WATER SUPPLY
3/4-INCH FLEXIBLE SHAFT AND GUIDE PIPE
TO AFT GATE VALVE
OVERBOARD DISCHARGE RISER
SUPPLY LINE FROM FIRE MAIN
VALVE TERMINAL
FIXED EDUCTOR
SEE DETAIL A
GATE VALVE
BELL MOUTH
BOTTOM OF COFFERDAM
FLOW DIRECTION OF DISCHARGE TO OVERBOARD
TAIL
NOZZLE
GASKET
FLOW DIRECTION OF SALT WATER SUCTION
FLOW DIRECTION OF SALT WATER FROM FIRE MAIN
DETAIL A

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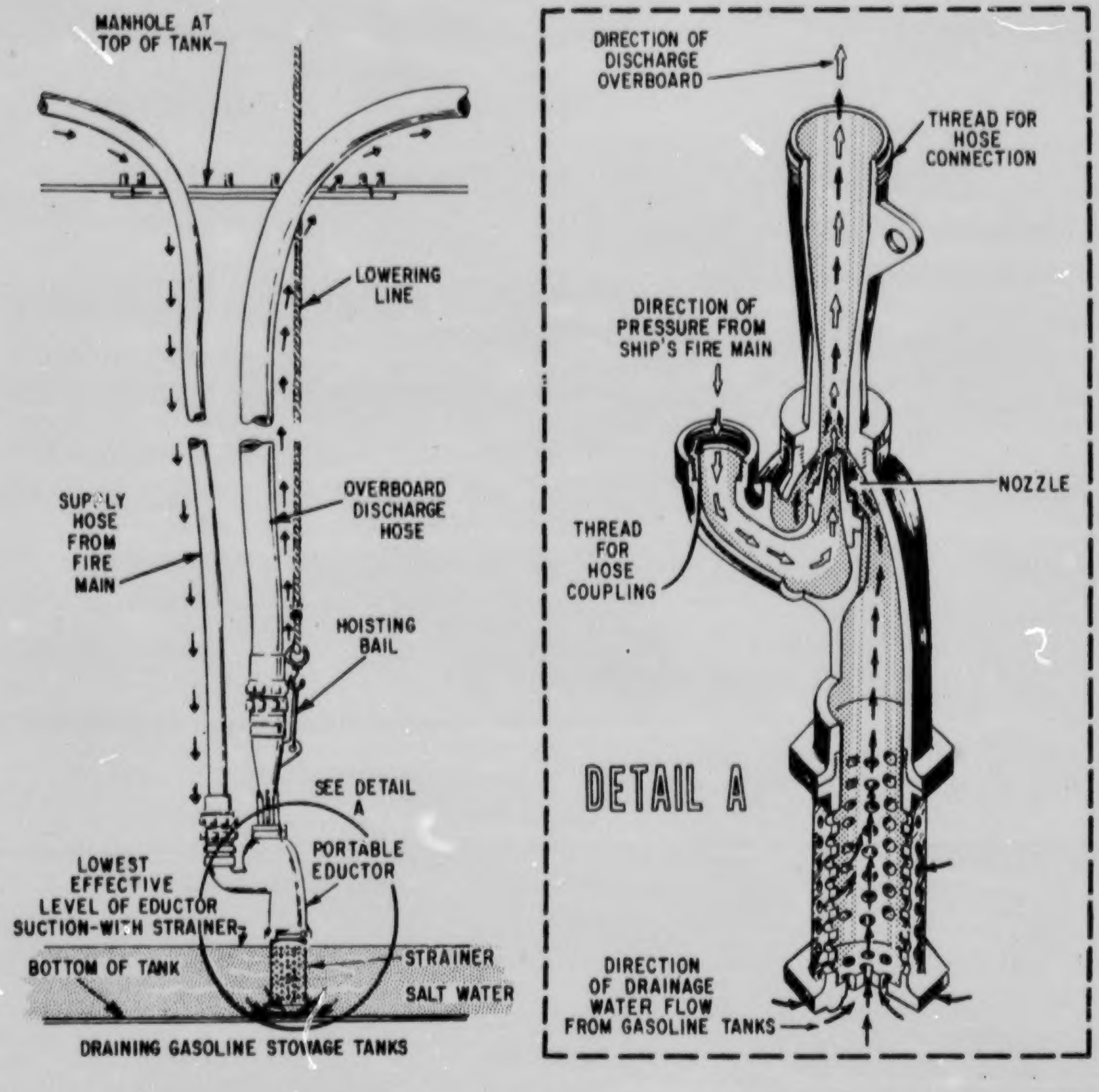
Figure 5-17.–Cofferdam fixed eductor.


MANHOLE AT TOP OF TANK
LOWERING LINE
SUPPLY HOSE FROM FIRE MAIN
OVERBOARD DISCHARGE HOSE
HOISTING BAIL
SEE DETAIL A
PORTABLE EDUCTOR
LOWEST EFFECTIVE LEVEL OF EDUCTOR SUCTION-WITH STRAINER
BOTTOM OF TANK
STRAINER
SALT WATER
DRAINING GASOLINE STOWAGE TANKS
DIRECTION OF DISCHARGE OVERBOARD
THREAD FOR HOSE CONNECTION
DIRECTION OF PRESSURE FROM SHIP'S FIRE MAIN
NOZZLE
THREAD FOR HOSE COUPLING
DETAIL A
DIRECTION OF DRAINAGE WATER FLOW FROM GASOLINE TANKS

197.34

Figure 5-18.—Portable eductor.

ships have the Okadee valve (a sliding gate type valve) or butterfly valve. The oldest and most common type is the nonlubricated positive stop valve. Sylphon packless glove valves are used in all small diameter piping. These valves are described in detail later in this chapter. In describing the piping and valve arrangement they are referred to only as shutoff valves without reference to type.

The aviation gasoline pumproom, which contains the aviation gasoline pumps, sea water pumps, and many of the valves which control the distribution of fuel, is located on the 5th deck directly above the stowage tanks. Access to the pumproom is gained through a vertical trunk which extends from the 2nd to the 4th deck.

The motors for the AvGas pumps are located in the same adjacent pump motor-room as the sea water pumps. They too are connected by motor shafts which pass through bulkhead stuffing boxes. All motors (both sea water and AvGas) are started and stopped by means of a reach through pushbutton mechanism, which is welded in the watertight bulkhead between pumps and motor room.

The drawoff tank supply riser extends up from the top of the drawoff tank to the common suction header of the AvGas pumps in the pumproom. (See fig. 5-19.) The valve in this line is referred to as the "tank top shutoff valve." The drain line header and the flushing suction line interconnect with the supply riser below the tank top valve. A steam out connection for steaming the distribution piping and a reflex type sight glass gage for observing the fuel level when draining back are installed above the valve.

The reflex type gage is so designed that liquid shows black, contrasted with a bright, mirror-like appearance when no liquid is present.

Nitrogen, used for draining back, purging, and charging the distribution system is piped into the pumproom from the N_2 plant. The main supply line is fitted with a shutoff valve and a one-way check valve. Three lines, each fitted with a shutoff valve, branch off the main supply line below the one way check. One line extends up to the filter room and supplies the nitrogen for draining back the system. The other two are connected to the common suction header and recirculating header and are used for purging and charging the system.

The common suction header supplies fuel to both pumps under a continuous positive pressure. Each pump inlet line contains a shutoff valve and compound gage (VP).

The AvGas pumps (referred to as booster pumps) are the double-suction centrifugal type. Each pump is provided with an independent vent line. This line, fitted with a shutoff valve, extends from the extreme top of the pump casing to the common discharge header.

The pump discharge line contains a pump drain line, pressure gage (P), recirculating line, one-way check valve (with drain line), and a shutoff valve.

The drain lines are provided to drain the check valve, pump, and pump discharge piping, up to the check valve, back to the drawoff tank when draining back the system. The pumps and check valve drain lines, each fitted with a shut-off valve, are combined into one line which terminates in a common drain line header.

The drain line header, which is also connected to the pressure regulator drain line, interconnects with the drawoff tank supply riser below the tank top shutoff valve. This line is fitted with a one-way check valve and a shutoff valve, located near the tank top valve.

The pump recirculating line, fitted with a one-way check valve, an orifice, and a shutoff valve, terminates in a recirculating header. The orifice is designed to limit the flow to approximately 5 percent of the rated capacity of the pump. This recirculated fuel prevents over-heating of the pumps during prolonged standby periods (when the pumps are running but no fuel is being drawn off topside). A warning plate is fitted near each recirculating line shutoff valve which states; VALVE MUST BE OPEN BEFORE STARTING AVIATION GASOLINE PUMP.

Both pump recirculating lines combine with the pressure regulator recirculating line into a common header. The recirculating header, fitted with a tank top shutoff valve, terminates in a diffuser, at midpoint in the drawoff tank.

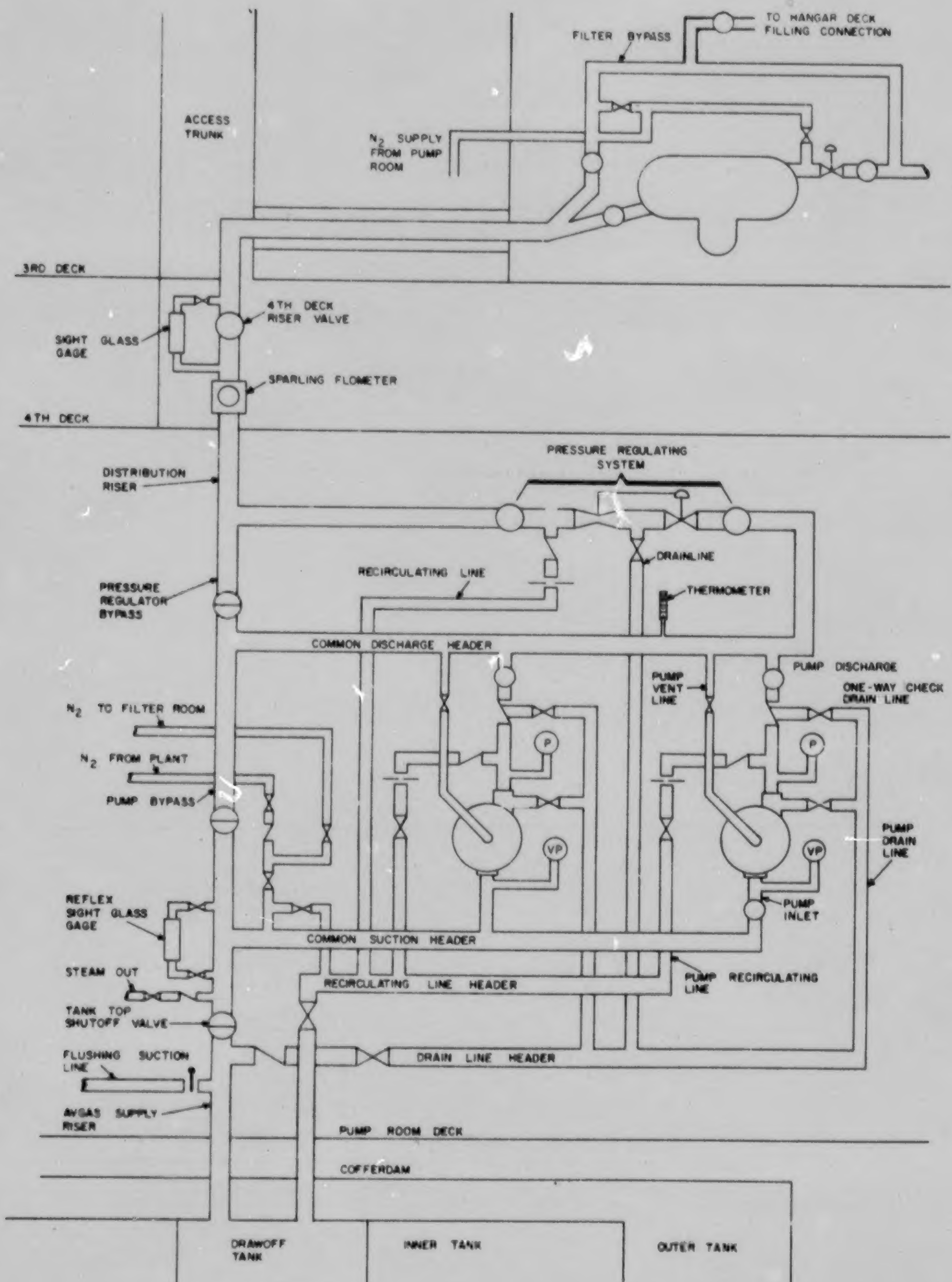
A thermometer is installed in the common discharge header to determine the temperature of the fuel being discharged from the pumps. (The maximum allowable temperature is 100° F.)

The pumps are provided with a bypass line which extends from the common suction header to the common discharge header. This line, fitted with a shutoff valve, is used when venting, draining back the system, receiving AvGas aboard, and any other operation not requiring the pumps.

All quadrant distribution risers in a high-capacity aviation gasoline system are identical regardless of the type service stations (Blackmer or Cla-Val) installed.

Each riser is equipped with a pressure regulating system at the pumproom level.

NOTE: Since there are no independent defueling mains in the AvGas system and all fuel must be defueled back into the riser, the riser pressure at the service stations must be maintained below the discharge pressure of the defueling pumps.


TO HANGAR DECK FILLING CONNECTION
FILTER BYPASS
ACCESS TRUNK
N2 SUPPLY FROM PUMP ROOM
3RD DECK
4TH DECK RISER VALVE
SIGHT GLASS GAGE
SPARLING FLOMETER
4TH DECK
PRESSURE REGULATING SYSTEM
DISTRIBUTION RISER
DRAINLINE
RECIRCULATING LINE
THERMOMETER
PRESSURE REGULATOR BYPASS
COMMON DISCHARGE HEADER
PUMP DISCHARGE
PUMP VENT LINE
ONE-WAY CHECK DRAIN LINE
N2 TO FILTER ROOM
N2 FROM PLANT
P
PUMP BYPASS
P
PUMP DRAIN LINE
VP
VP
REFLEX SIGHT GLASS GAGE
PUMP INLET
COMMON SUCTION HEADER
STEAM OUT
PUMP RECIRCULATING LINE
RECIRCULATING LINE HEADER
TANK TOP SHUTOFF VALVE
DRAIN LINE HEADER
FLUSHING SUCTION LINE
AVGAS SUPPLY RISER
PUMP ROOM DECK
COFFERDAM
DRAWOFF TANK
INNER TANK
OUTER TANK

198.45

Figure 5-19.—Gasoline piping and valve arrangement.

All pressure regulators are identical except for physical size. Pressure settings will vary depending on the class ship and type service station. Each regulator is provided with a drain line and a recirculating line. On ships equipped with 675 gpm and 1,100 gpm AvGas pumps, the recirculating line is orificed to recirculate 100 gpm. However, on ships equipped with 425 gpm and 220 gpm pumps the line is orificed to recirculate only 40 gpm and 20 gpm respectively.

The pressure regulator is provided with a valved bypass line. This line is used when venting, draining back, and receiving AvGas aboard.

The distribution riser extends up through the vertical access trunk. A totalizing meter, sight glass gage, and a shutoff valve are installed in each riser just above the 4th deck level. (The shutoff valve in this line is referred to as the "4th deck riser valve".)

Each meter is designed to accurately measure flow in either the forward or reverse direction. The meter houses a totalizing register which shows continuous registration in units of 100 gallons and a sweep hand and a dial graduated in 1-gallon increments. The meter is so arranged that when fuel flows to the stowage tanks, the meter advances the totalizer readings, and when fuel is pumped from the stowage tanks, the meter subtracts the totalizer readings. The meter thus registers the net flow delivered to the stowage tanks. The meter will also register when nitrogen passes through the system during drain back and purging operations. The line level gage has been installed just above the meter to show when fuel is above the meter. Observation of the gage will indicate when the meter is being actuated by nitrogen or fuel. This meter should NEVER be used to determine the amount of fuel in the stowage tanks.

The riser bends outboard just above the 3rd deck and passes through a horizontal trunk to the filter room. The section of the riser in the horizontal trunk is double-walled. The inner pipe carries aviation fuel, while the space between the inner and outer walls contains nitrogen gas under 10 psi. If a leak occurs in either the aviation fuel or gas-filled piping, a rise or drop in pressure will be indicated on a pressure gage in the pumproom and delivery must be stopped at once.

The filter room and outboard distribution piping and valve arrangement are practically identical to those previously described except for the following:

1. The hangar deck filling connection is either connected to the outboard distribution main or to the filter bypass line.
2. There are no defueling mains.

AVIATION FUEL METER

Aviation fuel meters (fig. 5-20) are found in two sizes in the fleet. The 6-inch flowmeter has an accurate flow range of 300 to 1,700 gpm in a forward or reverse direction. The 8-inch

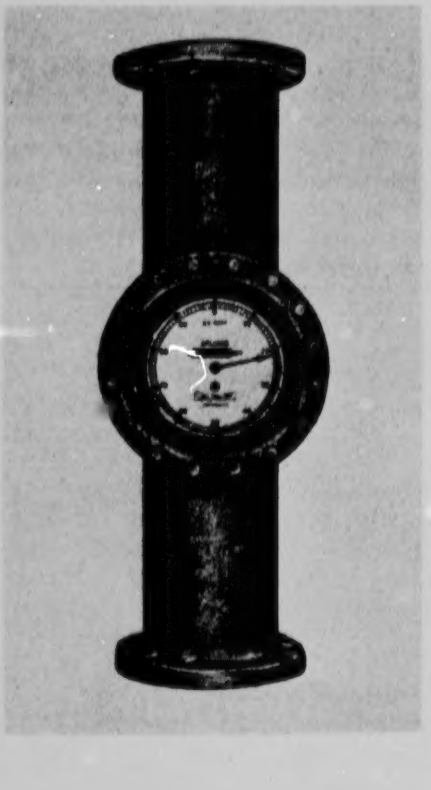


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Figure 5-20.—Sparling aviation fuel meter.

flowmeter has an accurate flow range of 400 to 2,000 gpm in a forward or reverse direction. Both are identical in construction and operation. No further reference will be made to size or capacity in this manual.

An aviation flowmeter of the propeller type is found in each quadrant distribution riser. The meter has two principal parts, the working mechanism (mounted in a removable headplate) and the tube for mounting the working mechanism in the line. The working mechanism consists of a propeller geared to a magnetic drive, which in turn is geared to an inset totalizer and sweep hand. The tube for mounting the mechanism flanges into the distribution riser. It contains straightening vanes to direct the flow of fuel to the propeller in either direction.

The operation of the meter is completely automatic. Downward or forward flow advances the totalizer and adds to the quantity registered (the sweep hand turns clockwise). The upward or reverse flow subtracts from the quantity registered (the sweep hand turns counterclockwise). Fuel flow turns the propeller, which is centered in the flow. The insert totalizer registers 100-gallon units. The sweep hand dial is graduated in 1-gallon units.

Once a year the meter is removed from the line and inspected. The propeller is checked by hand to insure that there is no binding; it should have about 1/32-inch free movement because of the play in the ball bearings. This play allows grit to pass between the bearings. Insure that the propeller blades are clean and not broken. Check the straightening vanes and tube for foreign matter. Lubricate the gears and bearings in the register clock with a light machine oil.

The meter needs no maintenance or lubrication between annual inspections.

A cover plate is provided to blank off the tube whenever the working mechanism is removed.

NOTE: The front ball bearing is the key to the life of the meter. If it is kept in proper condition, the other parts last almost indefinitely.

DOUBLE-WALLED PIPING

The double-walled piping consists of two concentric pipes. (See fig. 5-21.) The inner pipe is copper and carries the aviation fuel. The outer pipe is steel and serves as an armor casing. The outer pipe also serves to contain a protective jacket of inert nitrogen gas at about 10 psi around the inner piping. A pressure gage for each double-walled piping has been installed in the associated pumproom to indicate the pressure in the annular space. The gage has a

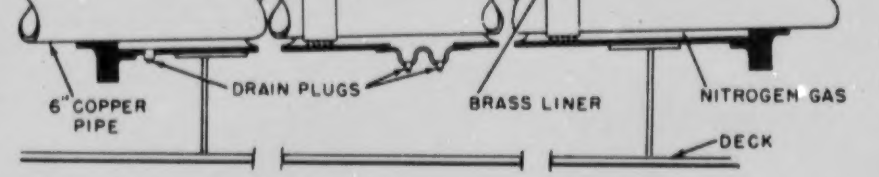

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Figure 5-21.—Section of double-walled piping.

range of from zero to 15 psi with a sector of from 9½ to 10 psi designated as the normal charging pressure.

If the outer casing is pierced for any reason, the nitrogen gas will leak out. The resulting drop in pressure will be indicated on the gage. Also, if a rupture should occur in the aviation fuel line inside the steel casing, the resulting increase in pressure will be indicated on the gage. Isolate the quadrant until the cause has been determined.

Expansion bellows are provided in the outer casing to avoid strains in the casing due to unequal expansion which may result in leakage of the nitrogen gas. Drain plugs in the bellows can be used to determine whether any leaks may have occurred in the inner piping. Brass liners soldered to the outside of the copper pipe and steel spacers welded to the inside steel casing are placed at intervals of about 5 feet. These serve to hold the copper pipe in the center of the steel casing and still allow for movement due to expansion and contraction between the two pipes. The outside casing is approximately 2 inches larger than the inner piping.

A nitrogen gas connection, for charging the outer casing, is provided at the lower or inboard end of the double-walled piping. The outer casing is also provided with a relief valve to avoid excess pressure. The released gas is vented to the atmosphere through separate piping. The relief valve is set at 15 psi.

POSITIVE STOP VALVES

As previously mentioned, there are three types of stop valves used. They are the rotary plug, swing gate, and butterfly valves. These valves are all positive stop valves and serve in the same capacity.

Positive stop valves are installed throughout the system. The valves are used (1) where the nitrogen gas could leak into or gasoline leak-out of stowage tanks when in a secured condition; (2) where nitrogen gas or aviation fuel could enter the fueling hose when in a reeled position; or (3) where quick opening or closing is required. Figure 5-22 illustrates a rotary plug valve.

The valve is of the nonlubricated type, and the body of the valve is made of bronze. The plug is cast steel with a ¼-inch coating of Hycar rubber. The stem packing is of cup-and-cone Teflon and the bonnet gasket is of Buna-N-Cork. A "Zerk" grease fitting is provided to lubricate the spindle and spindle nut.

Operation of the valve is as follows: to open the valve, the handwheel is turned in a counterclockwise direction, to unseat the valve.

During the raising operation, the stem cannot turn, as the ratchet is held in place by the ratchet pin. The raising of the plug brings the ratchet into contact with the stem nut. This is the limit of upward travel of the stem and plug. At this point, further turning of the handwheel in a counterclockwise direction turns the plug and ratchet. Each 90-degree turn of the handwheel turns the plug alternately from open to closed position, and is accompanied by an audible click as the ratchet pin falls in place into the ratchet. The direction of the port of the plug is indicated by a large two-headed indicator arrow above the handwheel.

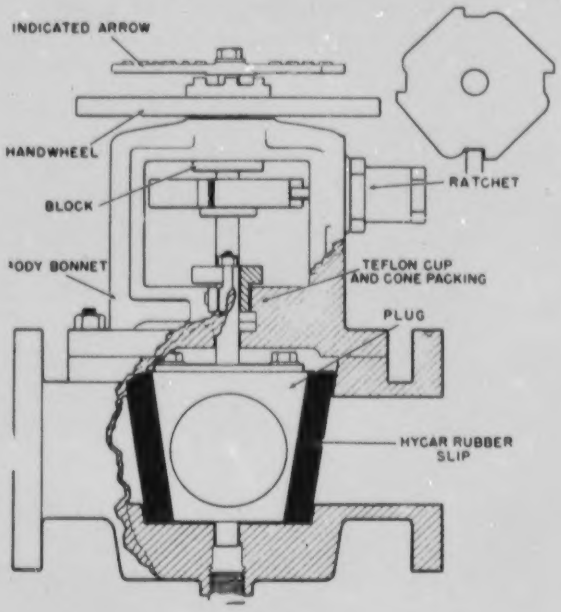

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Figure 5-22.—Rotary plug valve.

NOTE: The handwheel need not be turned with a wrench or any other lever to seat the plug. This would force the Hycar rubber face of the plug out through the port openings and cause damage to the plug.

To close the plug valve, turn the handwheel counterclockwise and raise the plug. Continue the counterclockwise rotation 90 degrees until the indicator shows the valve is closed and the ratchet pin falls in place. Turn handwheel in a clockwise direction until handtight. The valve will now be seated.

The Hycar rubber face of the plug may wear in use. Excessive wear will cause improper seating of the plug and leaks. The plug should be replaced when the handwheel nut touches the indicator, before the handwheel is turned handtight. The downward travel of the plug is thereby limited and improper seating occurs.

Okadee Swing Gate Valve

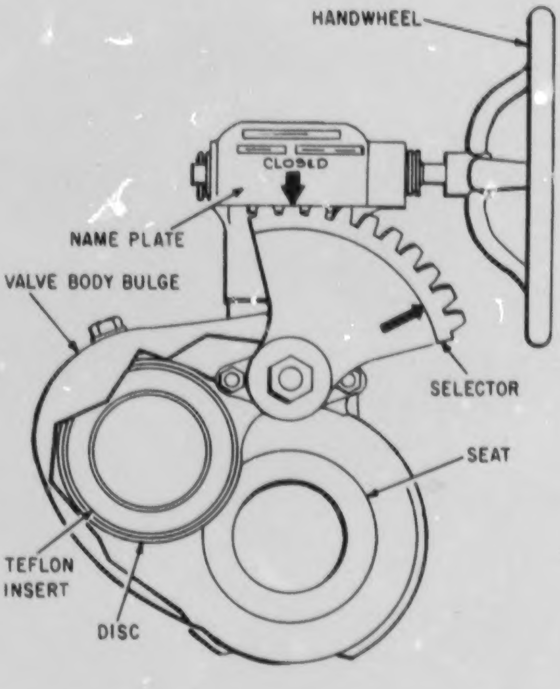
This valve will control fluid flow in both directions and is of the nonlubricated type. (See fig. 5-23.) The valve body is flanged and made of bronze while the seats are stellited nickel-plated steel. The discs have Teflon inserts to form the seal.

To operate this valve turn the handwheel counterclockwise, this will cause the gates to swing into the valve body bulge and open the ports for fluid flow. When closing this valve, back the handwheel off to release any strain which may have been applied. The valve is closed when the selector arrow and the nameplate arrow are aligned.

NOTE: When using wheel operated valves it is not necessary to exert excessive force. This adds additional strain and shortens stem packing life.

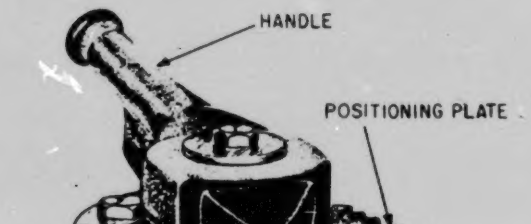
Butterfly Valve

The butterfly valve illustrated in figure 5-24 is relatively new in naval service. It is being used on some carriers in the aviation fuels system to replace the Atwood & Morrill Company positive stop plug valve. The butterfly valve is light in weight; it takes up less space than the positive stop plug valve; it is easy to overhaul; and it is relatively easy to operate.



197.50.1
Figure 5-23.—Okadee swing gate valve.

The butterfly valve consists of a body, a resilient seat, a butterfly-type disc, a stem, packing, a notched positioning plate, and a handle. This valve provides a positive shutoff and may be used as a throttling valve set in any position from full open to full closed. The replaceable resilient seat is held firmly in place by mechanical means; neither bonding nor cementing is necessary. It is not necessary to grind, lap, or do machine work to replace the valve seat, so overhaul of the valve is relatively simple. The resilient seat is under compression when it is mounted in the valve body, thus making a seal around the periphery of the disc and both upper and lower points where the stem passes through the seat. Packing is provided to form a positive seal around the stem in the event that the seal formed by the seat becomes



197.52.1

Figure 5-24.–Butterfly valve.

damaged. When closing the valve, the handle needs only to be turned 90 degrees.

Sylphon Packless Globe Valve

The sylphon packless glove valve is used to eliminate the hazardous leakage of gasoline past the packing in the ordinary valve by providing a metal bellows (sylphon) which prevents liquid from escaping through the valve stem opening. (See fig. 5-25.)

Sylphon packless globe valves are used in the pumproom on the drainage piping from the centrifugal pumps, on other small-diameter pipe lines carrying gasoline or nitrogen, and on steaming-out connections.

The sylphon packless globe valve controls the flow of liquid through a pipe in the same manner as the ordinary globe stop valves.

When the control handle is turned, a poppet at the end of the valve stem is lifted from a valve seat and permits flow through the valve. It has an expansible metal bellows (or sylphon) assembled between the valve poppet and the bonnet capnut. This permits the valve stem to be raised or lowered while maintaining a complete seal around the stem at all times. In the ordinary globe valve, a fiber packing is used to prevent the escape of liquid. This packing deteriorates or shrinks, and allows dangerous leakage of liquid or vapor. The sylphon bellows may be replaced if it corrodes or breaks.

NITROGEN SYSTEM

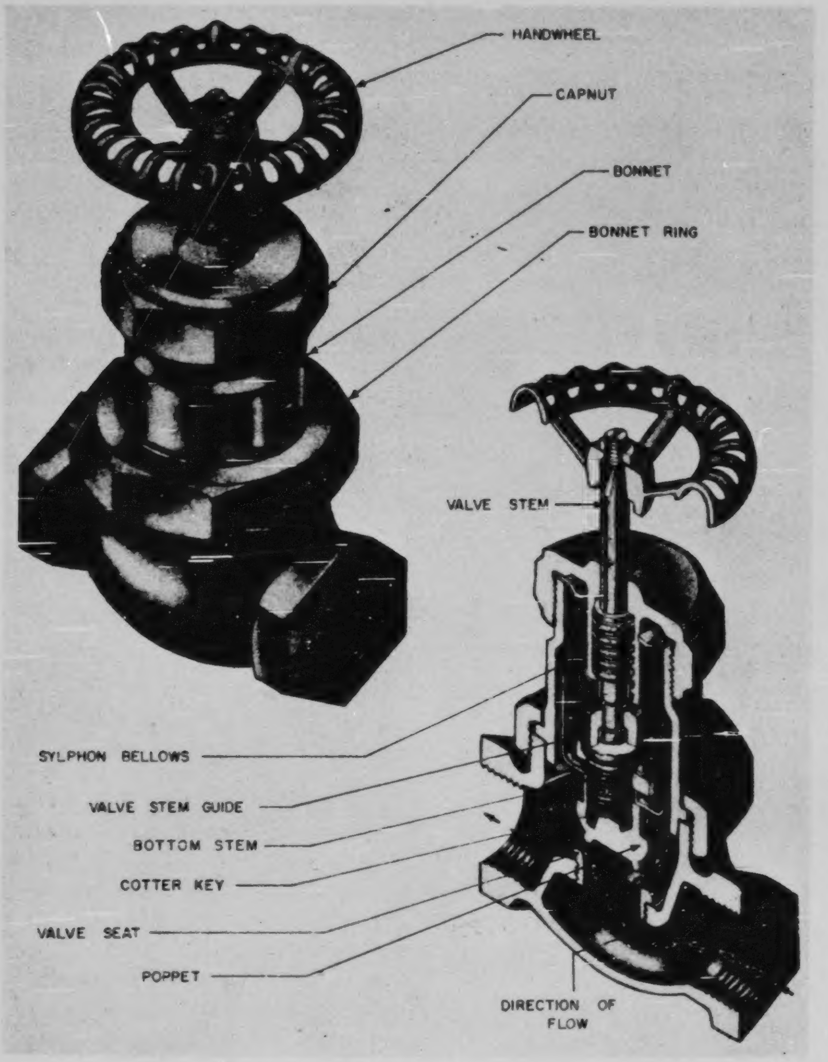
Nitrogen is manufactured aboard ships in oxygen-nitrogen producer rooms. Nitrogen, obtained in the fractional distillation of liquid air, is stored in flasks at 3,000 psi for use as required. Nitrogen is an ordorless, colorless, tasteless gas and is a nonconductor of electricity. In the manufacturing process, nitrogen purity is maintained at a minimum of 97 percent.

Nitrogen is used in cofferdams as a protection against fire and explosion, in double-walled piping to indicate the condition of the double-walled piping, and in the distribution piping for drainback, purge, and charge. A reducing panel in the producer room routes nitrogen to the using points in the aviation fuels system.

At the reducing panel (fig. 5-26), nitrogen pressure from the flasks is first reduced from 3,000 psi to 300 psi to facilitate subsequent reduction. It is then reduced and routed as follows:

300 psi to 4 psi to cofferdams.
300 psi to 10 psi to double-walled piping.
300 psi to 15 psi to distribution piping.

Each reducing valve is provided with a bypass line containing a globe needle valve. The


HANDWHEEL
CAPNUT
BONNET
BONNET RING
VALVE STEM
SYLPHON BELLOWS
VALVE STEM GUIDE
BOTTOM STEM
COTTER KEY
VALVE SEAT
POPPET
DIRECTION OF FLOW

198.49

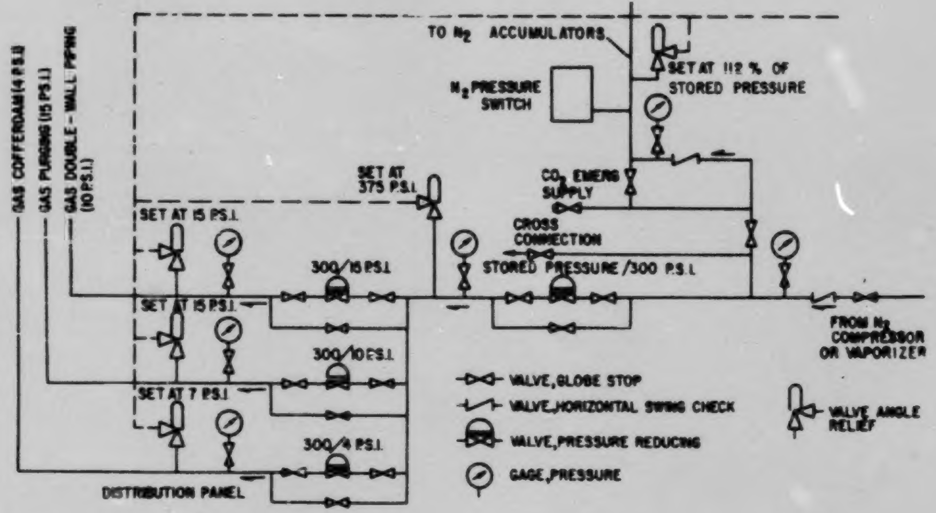
Figure 5-25.—Sylphon packless globe valve.

reducing valves are bypassed when using carbon dioxide.

NOTE: In an emergency, 50-pound carbondioxide bottles may be released into a nitrogen flask (through a connection in the producer room) and routed to the using points. There are two oxygen-nitrogen plants aboard ship (one forward and one aft), cross-connected so that nitrogen can be routed to any fuels system from any plant.

CHARGING OPERATIONS

The double-walled piping is supplied with nitrogen from the reducing panel through a


GAS COFFERDAM (4 P.S.I.)
GAS PURGING (15 P.S.I.)
GAS DOUBLE – WALL PIPING (10 P.S.I.)
TO N2 ACCUMULATORS
N2 PRESSURE SWITCH
SET AT 112 % OF STORED PRESSURE
SET AT 375 P.S.I.
CO2 EMERG SUPPLY
CROSS CONNECTION
SET AT 15 P.S.I.
300/15 P.S.I.
STORED PRESSURE /300 P.S.I.
SET AT 15 P.S.I.
300/10 P.S.I.
SET AT 7 P.S.I.
300/4 P.S.I.
DISTRIBUTION PANEL
FROM N2 COMPRESSOR OR VAPORIZER
VALVE, GLOBE STOP
VALVE, HORIZONTAL SWING CHECK
VALVE, PRESSURE REDUCING
GAGE, PRESSURE
VALVE ANGLE RELIEF

197.56

Figure 5-26.—N_2 pressure-reducing panel.

charging valve located in the third deck access trunk. Insure that the casing vent valve is closed prior to opening the charging valve. The double-walled piping pressure gages are located on the main gage panel in the gasoline pumproom. Slowly open the charging valve; when pressure on the gage reaches 10 pounds per square inch, close the charging valve. (A relief valve set at 15 psi is provided on the casing.)

CAUTION: If double-walled piping pressure drops below 5 psi or rises above 10 psi, isolate the double-walled piping until the cause of pressure change is detected and corrected.

Nitrogen is supplied to the cofferdams at 4 psi from the reducing panel. An air escape riser from each cofferdam to overboard contains a stop valve. A bypass line around the air escape riser valve is provided with a relief valve (set at 4 psi), a pressure gage, and an inertness analyzer connection. To charge the cofferdams:

1. Open the air escape riser valve.
2. Attach inertness analyzer to cofferdam test cock.
3. Open nitrogen supply valve to cofferdam. When inertness reading reaches 50 percent close the air escape riser.
4. Charge cofferdams to a minimum ½ psi, then secure the supply valve.

The cofferdams are checked daily with the portable inertness analyzer. Maintain ½ psi, 50 percent inertness for safe operation.

Nitrogen for drainback is injected in the distribution piping through the filter discharge and filter bypass line. It is routed from the reducing panel to a supply valve in the pumproom, and from the pumproom through two stop valves—one to the port, one to the starboard filter.

To drain back a quadrant:

1. Open nitrogen supply in gas pumproom.

2. Open nitrogen valve to filter room.

3. Open nitrogen drainback lines to filter bypass and filter discharge lines. When the suction header reflex sight level gage indicates the piping is empty, isolate the AvGas tanks.

Secure nitrogen valve to filter and purge.

To purge a quadrant:

1. Open nitrogen valve to gas pump suction header.
2. Start the farthest service station from the pumproom and place it in fuel position. Connect an inertness analyzer to the air and vapor eliminator exhaust line. When inertness reading reaches 50 percent, secure the station.
3. Charge the piping to 9.5 psi.
4. Secure the nitrogen supply valve and nitrogen to suction header valve.

NOTE: JP-5 quadrants are drained back with nitrogen only in an emergency. Gasoline quadrants are drained back each day after operation.

Whenever using carbon dioxide, in place of nitrogen, purge to 35 percent inertness minimum.

NITROGEN PRESSURE REGULATING VALVE

The nitrogen regulating valve consists of a dome and body separated by a rubberized diaphragm. The diaphragm actuates the poppet valve in the valve body by forcing down the valve stem. A compression spring below the poppet valve tends to return the valve to its seat against the force of the diaphragm. The dome is filled with nitrogen gas under pressure when the valve is adjusted. This gas pressure acts on the upper surface of the diaphragm. A pressure chamber on the under side of the diaphragm fills with nitrogen through an opening to the discharge, or low-pressure, side of the valve. Thus, when the valve has been adjusted and is in operation, the pressure on the upper side of the diaphragm acts to force the valve open. This force is balanced by the low-pressure gas on the under side of the diaphragm and the spring under the poppet valve. When low-pressure gas is taken from the system, the pressure on the discharge side starts to fall and the regulating valve opens to permit passage of gas from the high-pressure side of the valve. The distance the valve opens depends on how fast the low-pressure gas is being used. When use of low-pressure gas is stopped, the pressure on the under side of the diaphragm starts to increase and the valve closes to stop the flow of high-pressure gas.

When the regulating valve is being adjusted, nitrogen gas from the high-pressure side of the valve is admitted to the dome chamber through an orifice controlled by two needle valves. (See fig. 5-27.) A ball relief valve to the orifice will release gas if the high pressure needle valve in the body is opened too far.

To put the reducing valve in operation:

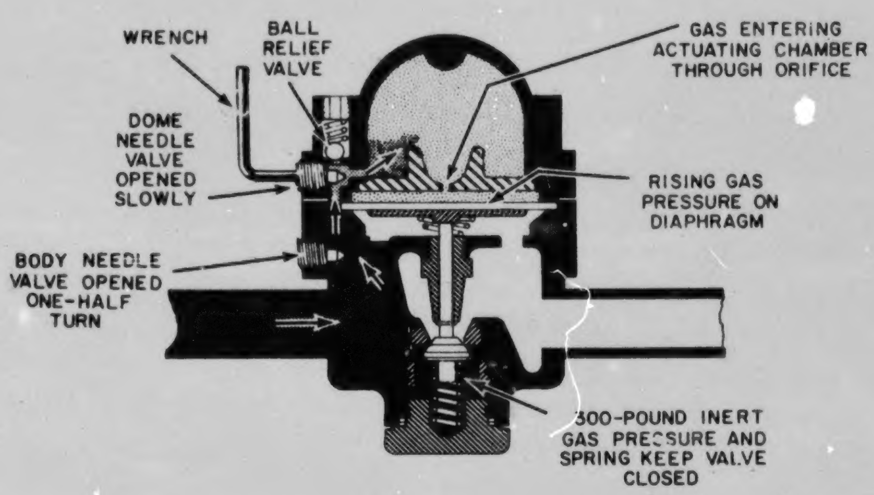
1. Close the valve body needle valve and dome needle valve.
2. Close the stop valve on the low-pressure side. Open the inlet valve on the high-pressure side and open the low-pressure gage valve.
3. Open the body needle valve one-half turn to permit gas to flow into the loading channel.
4. Open the dome needle valve slowly. This permits gas to flow into the dome. Gas entering the dome flows through the orifice in the dome plate and acts on top of the diaphragm.
5. The increasing gas pressure forces the diaphragm down and slowly opens the valve. Gas then flows through the valve opening into the low-pressure side of the valve and into the lower pressure chamber, where the increasing pressure of the gas acts on the under side of the diaphragm, pushing it up to close the valve. (See fig. 5-28.) When the low-pressure gages register the desired pressure:
6. Close the dome needle valve.
7. Close the body needle valve.

The valve is now adjusted and ready for use.

Figure 5-29 shows the pressure regulating valve in operation.

CO_2 SYSTEM

Carbon dioxide is stored in steel cylinders at pressures from 700 to 1,000 psi, depending on variations in termperature. At these pressures, about two-thirds of the cylinder's contents is in liquid form. As gas is released through the opened cylinder valve, the pressure is gradually lowered until all the CO_2 turns into gas. Thus, the contents of CO_2 in the cylinder will expand


WRENCH
BALL RELIEF VALVE
GAS ENTERING ACTUATING CHAMBER THROUGH ORIFICE
DOME NEEDLE VALVE OPENED SLOWLY
RISING GAS PRESSURE ON DIAPHRAGM
BODY NEEDLE VALVE OPENED ONE-HALF TURN
300-POUND INERT GAS PRESSURE AND SPRING KEEP VALVE CLOSED

198.50

Figure 5-27.—Loading the dome (pressure regulating valve).

about 450 to 500 times in volume when it is released. When fully charged, the large-size cylinders contain 50 pounds of CO_2.

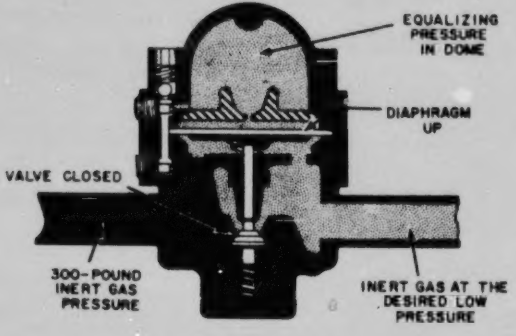
Carbon dioxide is used for the protection of the aviation fuel pumproom, motor room, access trunk, and aviation fuel filter rooms. Carbon-dioxide cylinders are located in motor rooms and in compartments on the second deck directly above the filter rooms. The CO_2 release valves on the cylinder are operated by a cable, with cable pull boxes located at several places. The cylinder valves are thus opened but can not be closed. Spare CO_2 cylinders are carried aboard.

The CO_2 Emergency Fire Extinguishing System for aviation fuel pumprooms, motor rooms, access trunks, and filter rooms, is similar on all class carriers.

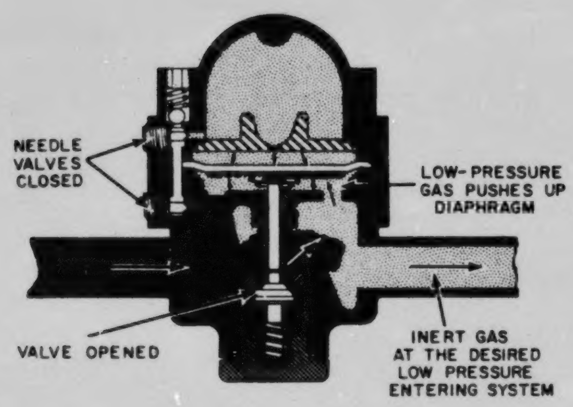
There are eight carbon-dioxide cylinders, located inside each of the motor rooms, four of which are connected by piping to the aviation fuel pumproom, motor room, and access trunks; the other four are spares. The cylinders release carbon dioxide into the piping, when operated by any one of three pull boxes. A pull box is located inside the third-deck access trunk, one outside the second-deck access trunk, and one on the hangar deck.

For the after aviation fuel filter rooms, six cylinders, three per filter room, are located on the second deck in compartments directly above the filter rooms and are connected by piping to the filter rooms. A pull box is located outside each access trunk on the second deck and on the hangar deck, one port and one starboard. For the forward aviation fuel filter rooms, four carbon-dioxide cylinders, two per filter room, are also located on the second deck and are connected by piping to the filter room. Pull boxes are located outside each access trunk and on the hangar deck, one port and one starboard.

The emergency pull box is watertight and has a metal cover with a rubber gasket held by friction clutches on the rim. Under the cover is a labeled glass plate with instructions for using the pull box, and under the glass plate is a pull handle connected through a cable and pulley to a type 1, class C, cylinder valve on the carbon-dioxide cylinder head. The pull box is operated by releasing the friction catch to allow the cover plate to drop; then break the glass and pull out the handle until the red portion of the pull cable can be seen. Released carbon-dioxide gas flows through the piping to the aviation fuel spaces, where it is discharged through diffusing


EQUALIZING PRESSURE IN DOME
DIAPHRAGM UP
VALVE CLOSED
300-POUND INERT GAS PRESSURE
INERT GAS AT THE DESIRED LOW PRESSURE

198.51
Figure 5-28.—System balanced, valve closed.


NEEDLE VALVES CLOSED
LOW-PRESSURE GAS PUSHES UP DIAPHRAGM
VALVE OPENED
INERT GAS AT THE DESIRED LOW PRESSURE ENTERING SYSTEM

198.52
Figure 5-29.—Valve in operation.

horns and spreads as a smothering blanket, eventually filling the compartment.

Connections from the carbon-dioxide cylinder distribution lines allow carbon dioxide to operate two pressure switches. Pressure from the carbon dioxide throws electric switches to actuate a carbon-dioxide warning bell in the space, a visual alarm outside the space at the access, and to stop the exhaust ventilation system fan motors. Stoppage of the ventilation system will cause operation of an audible and visible alarm on the hangar deck. (This ventilation audible-visible alarm is located in hangar bay 2, visible from conflagration station No. 2, on CVA-19 and CVA-34 class carriers, and in damage control central on CVA-41 class and up.) The hangar deck alarms consist of a bell, a green light labeled VENTILATION ON, a red light labeled VENTILATION OFF, and an electrical switch. When the ventilation for the space is operating normally, the green light glows, indicating ventilation blowers on. In the event of stoppage of a blower, the alarms for that space are actuated. The bell rings, the green light goes out, and the red light comes on. The bell may be turned off prior to restoration of ventilation to the space by turning the electrical switch to the OFF position. The red light will continue to glow until ventilation is restored at which time it will go out and the green light will come on. Reset the bell by turning the electrical switch to ON.

The pressure switches, actuated by the action of released carbon dioxide, can be reset by pressing down on the plunger on the top of each switchbox.

After releasing carbon dioxide into a space, all doors and hatches must be closed and dogged tight. Since carbon dioxide is suffocating, every effort should be made to remove all members of the crew before the gas is discharged.

Do not reenter a compartment in which CO_2 has been released without respiratory protection or until the ventilation has been operating at least 15 minutes and the gas-free officer has made the necessary test to insure safe entry.

TESTING FIXED CO_2 SYSTEMS

Weekly tests of the pressure actuated toggle switches installed in fixed CO_2 systems are accomplished as follows:

Walter Kidde Installations

1. Pull outside button to release latch.
2. Pull end button to actuate switch.
3. Inspect ventilation system audible alarm and visual alarm circuits to verify circuit actuation.
4. After completion of the testing of the circuits and operation of the switch, reset the switch by returning end button to set position.

CO2 Installations

1. Disconnect ¼-inch pipe at union connection.
2. Insert a small rod in the ¼-inch pipe leading to the cover.
3. Push upward against the steel piston to actuate the switch.
4. Inspect ventilation system, audible alarm, and visual alarm circuits to verify circuit actuation.
5. After completion of testing the circuits and operation of the switch, push reset plunger down to reset the switch.
6. Reconnect ¼-inch pipe at union connection. A tight seal at the union after connection must be maintained.
7. When testing, or conducting maintenance, large signs warning personnel of the nature of work in progress must be displayed at every access to spaces protected by the CO_2 system.

AUTOGAS SYSTEMS

This system provides stowage, fueling, and defueling facilities for combat vehicles aboard LPH and LPD class ships. The autogas system is basically the same as the AvGas system. The only noteworthy differences between the two are the number and location of the stowage tanks and the type of pumps used.

STOWAGE TANKS

Autogas stowage tanks consist only of an outer and drawoff tank. They are located on the centerline between the AvGas stowage tanks on LPH's and adjacent to the AvGas tank on LPD's. In both cases, they are within, and protected by, the same cofferdams as the AvGas tanks. The LPD's have a stowage capacity of approximately 22,000 gallons while the LPH's hold only 7,000 gallons. The outer tank sea water supply riser is connected to the overboard discharge line of the AvGas system.

AUTOGAS PUMPS

Both class ships (LPH and LPD) use waterturbine autogas pumps. There are two pumps in each pumproom. Pumps on LPH's have a rated capacity of 160 gpm at 90 psi and the LPD's have a rated capacity of 110 gpm at 60 psi. The waterturbine pumps are operated off the ship's fire main system. A pressure reducing valve is installed between the fire main supply line and the pump feed line. The sea-water exhaust used to operate the turbines is piped to the outer tank sea water supply riser for pressurizing the autogas stowage tanks.

Other component parts, such as filters, pressure regulators, flow meters, and service stations are the same as the ones for the AvGas system on each respective class ship.

AVIATION GASOLINE SYSTEM OPERATIONS

The aviation gasoline fuel system installed on aircraft carriers has the primary purpose of servicing piston-driven aircraft on the hangar and flight decks. The operating crew should always bear in mind that aviation gasoline is dangerous to handle and that all safety precautions should be adhered to at all times. For this reason, the system should be drained and inerted with nitrogen until a reading of 50 percent inertness or better is obtained, and then charged to a pressure of 9.5 to 10 psi at the end of each period of operation.

Lamicoid charts are provided in each gasoline pumproom, showing the diagram and operating instructions for the aviation gasoline system. These operating instructions give detailed procedures for performing the various operations and can be set up and checked on the operating diagram board. Operating personnel should familiarize themselves with the chart and refer to it when operating the system.

The descriptive sections of this chapter were written to give a better understanding of the system. The operating instructions are intended to supplement the Lamicoid charts.

Before putting the system into operation, open all gage valves and all but the drain valves on the reflex gages. These valves can remain open throughout the operations.

CAUTION: Open gage valves slowly when the system is pressurized to prevent damaging the gage. Always open the upper and lower valves simultaneously on differential gages

Check that all locked valves are locked in their respective positions. Locking devices should be in position at all times so that the above-mentioned valves cannot be operated accidentally. When it becomes necessary to operate a locked valve, insure that the valve is in the correct position before relocking it.

There are any number of operations and combinations of operations which might follow each other as the aviation gasoline systems are put into use. It would be impossible to determine what combination of operations might be required. For this reason, the valve alinement and sequence shown in the following operations are set up from the point of view that the system is drained and inerted and that all operational valves are closed. Unless a valve is specifically mentioned as being open, it should be closed.

NOTE: Before starting any aviation gasoline handling operations, check that nothing has been stowed that will interfere with easy access to the pull boxes for the gasoline pumproom and pump motor room, gasoline filter room, and fixed flooding CO_2 fire extinguishing system. Also check that nothing has been stowed that might interfere with the proper operation of the CO_2 release mechanism at the CO_2 bottle racks. Check to see that the CO_2 bottles are properly connected to the flooding manifold.

While studying the operation outlined in this chapter it is recommended that figures 5-16 (sea water piping) and 5-19 (AvGas piping) be continuously reviewed.

FLUSHING THE AVIATION GASOLINE STOWAGE TANKS

The stowage tanks should not be flushed or drained until all the aviation gasoline from the tanks have been transferred to another gasoline tank on the same ship or to another ship, a barge, or a railroad tank car.

To flush the saddle tanks, the following procedure should be observed:

1. Vent the distribution piping through the hangar deck filling connection, bypassing the pressure-regulating equipment and filter.
2. Pressurize the system with the sea water pumps.
3. When nitrogen pressure of 5 psi or less is obtained, open the tank valve and flood the distribution piping with sea water.

NOTE: The venting and flooding operations will be explained in detail later in this chapter.

4. Start the aviation gasoline pumps and commence the off-loading operation. Do not allow sea water to go any higher than the aviation gasoline pump suction header.

When all the gasoline has been pumped out of the tank, as determined by the tank gaging equipment and meter reading, secure the pumps.

Any aviation gasoline remaining after the pumping operation will be removed by flushing the tanks with sea water through the continuous operation of the sea water pumps.

CAUTION: The main gasoline pumps should not be used when flushing tanks because the pumps, provided with bellows shaft-seal packing, cannot be used to pump sea water for prolonged periods without damaging the packing.

Proceed with the flushing operations as follows:

1. Line up the sea water pumps to take suction from the outer tank supply riser and to discharge into the overboard discharge above the one-way check valve.
2. Unlock and close the ½-inch leak or bypass line.
3. Open the aviation gasoline pump bypass line and the hangar deck filling connection. The tanks are now vented to atmosphere.
4. Start one sea water pump. When the liquid in the distribution piping has been removed, as indicated by the sight glass gage on the aviation gasoline pump suction header, continue pumping for 2 to 3 minutes. With the system lined up as indicated above, sea water will be drawn out of the outer tank, lowering the water level in the drawoff tank below the flushing suction line. This line joins the drawoff tank suction riser to the sea water pump suction header. It is fitted with a spectacle flange or a pipe blind. Pocketed water remaining in the sea water line is to be removed with the pumproom eductor through the 1½-inch hose valve provided for this purpose.

5. Close the valve between the sea water pump suction header and the outer tank supply riser.

6. Connect the portable eductor and evacuate all possible sea water from the flushing suction line and the sea water pump suction header. Rotate the spectacle flange in the flushing suction line to the open position.

7. Open the valve in the flushing supply line. Sea water will now flow into the tanks from the sea through this line. Allow a little time for the tanks to refill.

8. Close the tank top valve and the filling connection valve. (With the system lined up as above, the sea water pumps NOW take suction from the drawoff tanks via the flushing suction line and discharge overboard.)

9. Start the sea water pump and flush until three complete changes of sea water have gone through the tanks. The time required for this operation depends on the tank size and the pump capacity.

NOTE: On the initial flushing operation, nothing but AvGas will be discharged through the sea water pumps. If excess leakage occurs at the pump packing gland, rotate the pumps. Prolonged pumping of AvGas will damage the graphite impregnated packing around the pump shaft.

10. After the flushing operation is completed, secure the sea water pump. Close pump inlet and pump discharge.

11. Connect an airhose to the steam-out connection on the gasoline pump suction header.

12. Open the drawoff tank top valve and apply air pressure to the drawoff tank. This will force the sea water out through the overboard discharge. Continue with the air until the tank gage reads empty, at which time, the drawoff tank will be completely empty.

CAUTION: Do not exceed the maximum allowable tank top pressure.

13. Secure the air and release the pressure in the tanks through the hangar deck filling connection. Water remaining in the sea water pump suction header and flushing suction line will now drain back to the drawoff tank.

14. Rotate the spectacle flange in the flushing suction line to the closed position.

Open and relock the ½-inch leak or bypass line. Inert the system and close all valves in the sea water and aviation gasoline system except those locked open and those normally open.

NOTE: The sea water pumps may be alternated on the line if desired; however, only one sea water pump should be in operation at a time.

DRAINING THE AVIATION GASOLINE STOWAGE TANK

Emptying the stowage tanks is normally a shipyard operation and is used only so that repair work can be accomplished after the tanks have been flushed.

1. Release the nitrogen pressure through the hangar deck filling connection, using all bypasses.

2. When a zero reading is obtained, close the aviation gasoline pump's bypass.

3. Close the sea chest valve.

4. Line up one sea water pump to take suction from the outer tank and discharge overboard.

5. Connect the airhose to the steam-out connection on the aviation gasoline pump suction header. Open the drawoff tank top valve and apply air pressure to the tanks.

CAUTION: Do not allow air pressure to exceed the maximum allowable tank top pressure at any time.

6. Start the sea water pump and operate until the pump starts to cavitate. This operation will not pump the tanks completely dry because of the height of the sluice pipes from the bottom of the tanks, but a sufficient amount of sea water will have been removed to allow the air to pass through the tanks. (Normally, both sets of stowage tanks forward or after, on ships with the CVS systems, are drained simultaneously to prevent putting excessive pressure on the centerline bulkhead.)

7. Close off the air supply and open the pump bypass valve. The tanks are now vented to

atmosphere. Allow the pressure in the tanks to reduce to zero psi.

8. Reduce the nitrogen pressure in the cofferdams to zero psi by opening the bypass valve at the nitrogen pressure relief valve for the cofferdams. If necessary, use the cofferdam fixed eductors to remove any accumulated liquid indicated by the static head liquid level indicator.

9. Remove the manhole cover to the cofferdam and install the portable ventilation system.

10. The contaminated air should be removed by suction. Air should be drawn from points in the tank as far from the access opening as possible, and preferably near the bottom, to insure complete removal of air. A blower may also be used to force fresh air through the inlet to assist the exhauster, but under no circumstances shall the contaminated air be allowed to exhaust freely through the open manhole while forcing fresh air into the space. This can be prevented by the use of a bloomer, made of canvas, which will allow the two hoses (inlet and exhaust) to pass through the manhole and close off the remaining space. The bloomer can be made up aboard ship.

Ventilation should be continued until the air has been completely renewed at least twice. (The volume of the space, divided by the cfm capacity of the blower, equals the theoretical time to change the air once.)

The exhaust vapor must not be allowed to discharge into any other compartment, but only to the outside atmosphere.

CAUTION: Use only air-motor driven blowers.

After the space has been ventilated as prescribed above, a test is made (1) with a combustible gas indicator for flammable vapors. If the test for flammable vapors is negative, the air is then tested for sufficient oxygen to support life by (2) using the flame safety lamp. The flame safety lamp must NOT be used if the combustible gas tests are positive.

No person is allowed to enter the space until after it has been determined safe by the gas-free officer or his authorized representative, using the above-prescribed method, and a signed certificate to that effect posted near the access opening, a copy of which will be given to the officer of the deck and to all other interested parties concerned.

The certificate, label, or tag will include the compartment number, date, time issued, and the signature of the authorizing person, and will indicate SAFE FOR MEN–SAFE FOR HOT WORK.

NOTE: The ventilation system for the pumproom should be in continuous operation throughout this operation.

STEAMING OUT AND CLEANING AVIATION GASOLINE STOWAGE TANKS

When it is necessary to enter gasoline tanks for repair work or inspection purposes, the compartments involved must be drained of all liquids and cleared of all gases which may be explosive, asphyxiating, or poisonous. These steaming and cleaning-out operations are usually performed at shipyards, but the ship's crew may be called upon to assist in this work, or asked to carry out the operations alone. After tanks have been emptied, they are steamed for 6 to 12 hours to "boil off" the more volatile materials which could generate explosive gases and to soften sludge adhering to the sides of the tanks that was not removed during the flushing and draining operation. There is also the serious danger of lead poisoning from any tank that has contained gasoline having a high tetraethyl lead content. To eliminate these dangers, the steaming and cleaning-out operations must be carefully followed.

CAUTION: Fire extinguishing apparatus and firefighting parties should be standing by during this operation.

1. Open filling connector and provide necessary pipe connection hose extension.

2. Unlock the outboard distribution emergency drain valves in the filter room. Open periodically to drain condensation.

3. Rotate spectacle flanges to the closed position in the outer tank supply riser.

4. Connect steam hose to the steam supply valve in the pumproom and to the steam-out

connection on outer tank manhole cover or the outer tank sea water supply riser on ships so equipped.

5. Apply steam pressure to one set of stowage tanks at a time and steam for 6 to 12 hours.

6. The steam will circulate through the tanks from the outer through the inner, and draw off via the sluice pipes and up through the distribution piping and out the filling connection on the hangar deck.

NOTE: Air pressure may be applied simultaneously with the steam to help force the steam through the tank.

CAUTION: The liquidometer units (on ships so equipped) in the tanks will not withstand a temperature higher than 230° F; therefore, the temperature in the tanks during steaming-out operation should not exceed 230° F.

7. After steaming for 6 to 12 hours, a test is made with the combustible gas indicator to determine the gas-free condition of the tanks. If a positive reading is received, continue steaming until a safe reading is obtained by the gas-free officer, at which time the steam may be secured.

8. Close the steam supply valve and continue with the air to cool off the tanks preparatory to entering.

NOTE: Any condensation that collects in the outboard distribution piping is drained overboard through the emergency drain lines for the distribution piping located in the filter room. Condensation that collects in the distribution piping within the ship will drain back to the drawoff tank.

9. When the tanks are cooled, open the outer tank top manhole cover and ventilate the outer tank.

10. After all vapor-freeing conditions are found to be satisfactory by the gas-free officer, or his representative, men may be sent into the tank to wash down the liquid coating with hot water. Portable eductors must be used during this washing operation and until all liquid possible has been pumped out. Ventilation must be continued and frequent gas-free tests made during this operation.

11. Follow the same procedure for the inner and drawoff tanks as outlined above for the outer tank.

12. After the washing and pumping operation, the tanks are closed up and then given a SECOND steaming out for not less than 4 hours, after which ventilation is resumed as above until satisfactory air conditions are again obtained.

13. When air conditions have been found satisfactory, men should again enter the tanks and scrape and wipe out the remaining liquid sludge and sediment until the tanks are thoroughly clean and dry. (NOTE: If the steaming operation is performed in a shipyard, a wheeler vacuum pump will be attached to the overboard discharge connection, and steam will be applied at the AvGas pump suction.)

Special Precautions When Entering Aviation Gasoline Tanks

Aviation gasoline contains larger amounts of tetraethyl lead than ordinary gasoline and, therefore, has a greater poisonous effect on the human system. The lead compound may enter the body through inhalation, by absorption through the skin, and by the mouth. No tank should be assumed to be free from the hazards of lead poisoning until the tank has been thoroughly cleaned and is dry, even though the combustible gas indicator shows that it is free of gasoline vapors.

Any person entering a gasoline tank for any purpose before it is completely and thoroughly CLEAN and DRY must wear an air-line-hose-mask, have a lifeline attached to him, and be attended by a reliable man outside.

Tank cleaning personnel and other persons entering gasoline tanks while sludge or liquid is present on the bottom of the tanks must wear gasoline-proof rubber hip boots, acid-resistant rubber gloves, and coveralls, (preferably white).

If any of the clothing gets soaked with gasoline or sludge, the wearer should leave the tank immediately and wash himself with soap and water. Raw gasoline will cause serious flesh burns. (NOTE: Personnel subjected to gasoline spray or soaking must be examined by a medical officer prior to reentering the tank.) At the end of each day, tools and equipment that come in contact with skin will be washed with soap and water and all air line hoses checked for defects.

Sludge removed from gasoline tanks and wiping rags soaked with sludge should be placed in a sealed container and, if at sea, sunk in deep water. If on shore, these items should be kept wet and buried, as soon as possible, in a remote place where they are not likely to be disturbed.

Tanks which have been thoroughly cleaned and gas-freed, ventilated, and tested by the above procedures may be classified and tagged SAFE FOR MEN–SAFE FOR HOT WORK, by the gas-free officer, at which time tank cleaners may dispense with the air line hose mask and continue with the tank repair work, using all precautionary measures set forth below.

Throughout the time that men are in the tanks, adequate ventilation must be maintained at all times and the flame safety lamp should be operating in the space and be under constant observation. In addition, the air must be tested frequently with the hydrocarbon vapor indicator, or at such interval as particular circumstances may require. Men should be withdrawn immediately if any unsatisfactory conditions arise and must not reenter the space until satisfactory conditions have been restored.

When sending men into such compartments or tanks, even after they have been cleaned and tested, a reliable man should stand by the manhole and keep count of the number of men in the space and maintain communication with them every few minutes to be sure that no one has been overcome.

The man in charge of the cleaning party insures that no matches or automatic lighters are carried by men working in such compartments or tanks and that shoes and clothing worn are of such character as to eliminate the risk of striking sparks by means of shoe nails, steel belt buckles, steel buttons, and so forth. All tools used in cleaning, (scrapers, buckets, and so forth) should be of rubber, wood, copper, brass, or fiber. No naked lights or sparking electric apparatus is permitted in any closed compartment nor in the vicinity of open manholes leading thereto. Portable lights, used by cleaning parties should be of the steam-tight-globe type, with all ferrous metal parts protected to prevent striking a spark.

When steaming and cleaning-out operations are complete, check and tighten all gasket joints that may have been loosened by the steaming.

Check other parts of the system for repairs which are not accessible when the tanks are in operation.

Remove the plug from one rotary plug valve and check the hycar rubber for excessive wear. Each time the system is steamed out, check a different plug valve. Replace manhole cover on each tank, making sure gaskets are in place.

Close and relock valve in the outboard distribution emergency drain line. Rotate spectacle flange in the outer tank supply riser to the open position.

If the piping has not been steamed out, inert the system and close all valves normally closed.

FILLING THE GASOLINE SADDLE TANK WITH SEA WATER

The stowage tank is located below the water line and, when empty, the tank is filled with sea water by venting the tank through the aviation gasoline filling connections and letting the sea water flow into the tanks by gravity.

To fill the tanks with sea water, the following procedure should be observed:

NOTE: Sea water should be taken on in deep water where the chance of picking up mud and silt from the bottom is remote. It preferably should not be done alongside a dock; if so, the water should be filtered.

1. Check that the valve in the sea water overflow line is locked open. If icing conditions exist, cut in the steam heating coils for the sea water overflow line shell connection and the sea water overflow line vent shell connection.
2. Vent the tanks through aviation gasoline distribution piping to the hangar deck filling connection, using all bypasses.
3. Line up the sea water piping to admit sea water to the outer tank from the sea chest via the sea water pump suction header and also the flushing supply line: (1) Open and lock the sea chest suction valve, (2) open the valve between sea chest supply riser and the sea water pump suction header, (3) open the valves between sea water pump suction header and the outer tank supply risers, (4) open the valve in the flushing

supply line, and (5) open and lock the ½-inch leak line. This will allow sea water to flow into the outer tanks and through the sluice pipe to the inner tank and drawoff tank.

4. When the tank gages for the inner tank read "EMPTY" (empty of aviation gasoline but approximately 95 percent full of sea water), the outer tank will be full and the inner tank will be nearly full of sea water. To continue filling the tanks with sea water, either one of two operations can be used: (1) Close off the valve in the flushing supply line and continue filling the tanks by throttling down the valve between sea chest supply line and the sea water pump suction header or (2) close off valve between sea chest supply line and sea water pump suction header and continue filling the tanks through the flushing supply line.

5. Continue filling the tanks until the reflex gage on the aviation gasoline pump suction header indicates the presence of liquid, then close the tank top valve between the drawoff and the aviation gasoline pump suction header.

6. Close all sea water valves opened in step 3 above, except those locked open. The locked-open ½-inch bypass leak-off connectoion, in the sea water cross-connection, serves as a source of sea water for keeping the tank completely filled with liquid and prevents excessive pressures in the tank which might result from temperature differences within and without the system.

7. Unless aviation gasoline is to be received immediately after this operation, secure the system and close all valves, except those locked open.

RECEIVING GASOLINE ABOARD

When aviation gasoline is to be taken aboard, there are certain preparations that must be made prior to receiving the fleet oiler or barge alongside. Some of the most essential ones are discussed in this section.

First, establish the amount of aviation gasoline to be received and the number and location of the tanks to be filled. The maximum allowable capacity required onboard will be 95 percent at sea or at anchor and 80 percent when the ship is alongside a pier.

If time permits, reduce to the minimum the number of tanks to be filled by transferring fuel from fore to aft on ships that are so equipped.

Aviation gasoline is received aboard ship through the starboard main deck filling connections. The forward fueling connection will be used when receiving aviation gasoline from a fleet oiler.

If replenishing from a fleet oiler, the following equipment should be assembled, tested, and ready for use.

At the filling connection, remove the blank flange and install the spool. Only nonsparking tools of the proper size will be used. The spool is equipped with a pressure gage, thermometer, and a valved test connection. Bolt the spool to the filling connection, using a Buna-N-Cork gasket. The male end of the quick-release coupling is bolted to the outboard end of the spool, using the same type of gasket.

Two head sets for the sound-powered telephone circuit must be on hand. Plug one set into the 4JG circuit on the ship and test. The additional set will be plugged into the jackbox received from the tanker for fueling station ship-to-ship communication.

A sampling kit, with an adequate amount of clean jars for taking frequent samples of fuel coming aboard, will be provided.

A 5-gallon safety can, rubber bucket, rags, and swabs will also be needed to clean up and dispose of any gasoline that may be spilled on the deck during the refueling operations.

When refueling from a barge or dock, some of the above-mentioned equipment will vary in that no quick-release coupling will be used in this operation and the ship may be required to furnish the hose, in which case the gasoline hose stored on board and plainly marked will be used for this purose, and this purpose only. Never use any hose for handling aviation gasoline that has been used to transfer other petroleum products. If the barge is equipped to deliver fuel through a 4-inch hose only, it must be adapted to connect to the ship's 6-inch filling connection. A 6-inch to a 4-inch reducer and/or a "Y" fitting connecting two 4-inch hoses to one 6-inch for expediting the refueling operation will be readily available.

When the word is passed to stand by to receive the tanker or barge, all firefighting equipment and fueling stations will be manned as prescribed by the ship's instructions. The smoking lamp will be out throughout the ship during this entire operation.

For the initial filling of the tanks with aviation gasoline, the following procedures should be observed:

1. Vent the system through the filling connection, using all bypasses as outlined below. Open pump bypass, pressure regulator bypass, fourth-deck riser valve, filter bypass, and the remaining valves (these valves will vary on different carriers) to the filling connection.
2. Introduce sea water into the tank by gravity until the reflex gage at the base of the gasoline pump suction header indicates the presence of liquid, then close the tank top valve.
3. After all messenger, telephone, trolley, and distance lines have been received and secured, stand by to receive the refueling hose.
4. Connect the ground wire, received from the tanker, to the filling connection (with the ground switch in "OPEN" position). The ground switch must be at least 10 feet from the filling connection and the ground wire firmly secured before it is "CLOSED."
5. When the fueling hose is received from the tanker, examine the gasket in the female half of the quick-release coupling to see if it is properly in place.
6. Direct the venting nozzle into a 5-gallon safety can and order the tanker to start pumping very slowly to expel all air and nitrogen from the fueling hose and piping. When a solid stream of aviation gasoline arrives at the venting nozzle, order the tanker to stop pumping. Close the vent hose valve.
7. Check that the sight glass gage on the gasoline pump suction header is full of liquid; if so, open the tank top valve and order the tanker to resume pumping at a slow rate. When the tank gage in the inner tank reads "EMPTY," notify the tanker to increase filling to a normal rate.

The gasoline must be delivered by the tanker to the main deck fueling connection with enough pressure to force the sea water out of the saddle tanks and up through the overflow loop. The pressure required will vary for different ships.

CAUTION: Do not exceed allowable tank top pressure.

When the tank gages indicate that the outer tank is almost full, stop the filling operations. Allow sufficient room in the gasoline tank for drainback of all gasoline in the piping.

8. Close the filling connection valve. Disconnect the fuel hose, and then the ground wire, and return them to the tanker.
9. Drain and inert the system and close all valves except those locked open.

NOTE: For subsequent filling of the aviation gasoline stowage tanks, the tanks will already be full of a combination of aviation gasoline and sea water.

To expedite the refueling operation, the distribution piping will have been vented and filled with aviation gasoline from the stowage tanks, prior to receiving the tanker alongside. With all bypasses opened, and only the filling connection and tank top valves closed, it will only be necessary to vent the fueling hose from the receiving source to the filling connection.

When receiving aviation gasoline aboard, a receiving log must be maintained. The following information will be entered in the log:

1. Date.
2. Time.
3. Source of receiving.
4. Meter reading.
5. Tank gage reading before and after receiving.
6. Gallons per minute received.
7. Tank top pressure while filling.
8. PSI at filling connection.
9. Quality of samples taken.
10. Amount received forward.
11. Amount received aft.
12. Total amount received.

During the fueling operation, frequent samples of the fuel being received will be taken at the sampling connection provided on the spool. The fuels officer will determine the frequency at which these samples will be taken.

If a sample is found to be contaminated, the fueling operation will be stopped. The contamination petty officer will notify the fuels officer, who will determine the extent of the contamination and make his report to the commanding officer. The commanding officer will make the final decision on whether to accept or reject the fuel based upon the fuels officer's recommendation.

The drawoff tank stripping pump will be used to remove all water and solids from the drawoff tank prior to and immediately after receiving aviation gasoline onboard, and also prior to any other aviation gasoline operation in which gasoline is to be drawn from the drawoff tank.

The stripping pumps are hand-operated. Operate the pump until aviation gasoline is observed in the sight glass provided. A sample of the contents of the drawoff tank can be taken through a valve supplied on the discharge side of the pump if desired.

FUELING AND DEFUELING AIRCRAFT

The procedure for fueling and defueling aircraft with aviation gasoline is practically identical with that described in chapter 4, for JP-5. Therefore, this section pertains only to the operation of the aviation gasoline distribution system from the pumproom to the service stations.

The following is a step-by-step operating procedure for venting, flooding, pressurizing, draining, and purging the high-capacity gasoline system.

Because of the hazards involved when handling aviation gasoline, it is MANDATORY that every possible safety precaution be adhered to before pressurizing the system.

The checkoff list included here was compiled not only for the safety of the ship but also for the safety of each operator. Prior to entering the pumproom access trunk, check for personal safety, such as:

1. No lighted cigarettes, cigars, pipes.

2. No matches or lighters.

3. No exposed ferrous nails, bits of metal or sand, and so forth, in shoes.

4. No keyrings or ferrous tools hanging from the belt.

Check the CO_2 system to insure that:

1. Nothing stowed will interfere with the proper operation of the pull boxes or cylinder valve levers.
2. Alarm switch is "ON."
3. Reset plunger is "DOWN."
4. Green light is "GLOWING."

Immediately upon entering the pumproom, check the operation of the ventilation system to insure that:

1. Fan motor is running.
2. Good airflow is coming out of the natural air supply.
3. Good airflow is going out of the forced exhaust.

Make preliminary checks, such as:

1. Zero-check the Taylor Static Head Gasoline Gage, if applicable, and purge as necessary.
2. Record the gage readings of the:
   a. Double-walled piping pressure (5 to 10 psi).
   b. Taylor Static Head Gasoline Gages or liquidometers.
      (1) Inner tanks.
      (2) Outer tanks.
   c. Cofferdams.
      (1) N_2 pressure (½ psi).
      (2) Inertness (50% minimum).
   d. AvGas distribution piping pressure.
3. Strip the drawoff tank. Obtain sample.
4. Before any operations are performed, establish communications over the 4JG circuit with the filter room, flight deck control, venting station on flight deck, and any other stations as necessary.

5. Set up the sea water system to pressurize the stowage tanks as follows: Open the sea chest supply riser, pump inlet, and discharge valves; open the valve between the discharge header and the outer tank sea water supply riser.

CAUTION: Insure that the three locked open valves (sea chest, ½-inch leak line, and overboard discharge) are properly positioned.

Vent the sea water pumps until a steady stream issues from the petcock at the top of the pump casing. Check the pumps for loose gear (rags, tools, etc.) and rotate each pump shaft by hand.

6. When flight deck control orders system venting, the AvGas piping and valves will be alined as follows: The pumproom operator will open the 4th deck riser valve, the pressure regulator's inlet, discharge, and bypass valves, and the pressure regulator's drain and recirculating lines. He will also open the pump's inlet, discharge, bypass, recirculating, vent, and drain valves, and the drain valve for the one way check valve.

The filter room operator will open the filter inlet, discharge, and bypass valves, and the filter vent line. He also opens the valves to the fore and aft outboard quadrant distribution legs.

The man at the flight deck venting station will ground a 5-gallon safety can to deck metals, ground an overwing nozzle to the can, place the nozzle in the can, and then open the nozzle–in that order.

7. After the valves are open to vent the N_2 pressure, check any gage in the AvGas distribution piping at the pumproom level; after N_2 pressure drops to 5 psi or lower, proceed.

8. Start one sea water pump and log the time. After the pump has come up to speed and capacity, check the tank top pressure gage.

CAUTION: If the tank top pressure gage reads ZERO or indicates a vacuum, stop the sea water pumps and check the valve alinement in the sea water system.

9. After pressurizing the stowage tanks as indicated by a positive reading on the tank top gage, flood the aviation gasoline distribution piping by:

a. Opening the tank top valve on the drawoff tank supply riser.

b. Open the tank top valve on the recirculating line header.

NOTE: Since there are NO THROTTLING valves in a high capacity aviation gasoline system, the distribution piping is flooded (to the filter room level) prior to starting the AvGas pumps to prevent putting a hydraulic shock on the filter elements.

10. When aviation gasoline is observed in the main fuel filter sump as reported by the filter room operator, close the following valves:

a. Filter, pressure regulator, and pump bypasses.
b. Pressure regulator, one way check valve, and pump drain lines.

11. The distribution piping is now ready to pressurize. Prior to starting an AvGas pump, check the oil level in the constant-level oiler, check for loose gear, and rotate the pump shaft by hand.

12. Start the aviation gasoline pump and log the time. When the pump discharge pressure gage indicates that the pump has reached its rated capacity, close the pump vent line.

13. Close the filter vent line when a steady stream of AvGas is observed at the bull's-eye sight glass gage; close the flight deck vent when a steady stream issues from the nozzle.

14. After all venting lines are secured, take a meter reading.

15. The system is now ready to fuel aircraft.

16. While the system is pressurized, check:

a. Fuel temperature (AvGas pump discharge header).
b. Pump bearing temperature (by hand).
c. Mechanical seal temperature (by hand).
d. Pump inlet and discharge gages.
e. Tank top pressure gages.
f. Automatic pressure regulator gages.
g. Pumps and piping for leaks.
h. Filter inlet and discharge pressure gages.
i. Log a, d, e, f, h, and any discrepancies encountered.

17. After all aircraft have been fueled and the system is ready to secure, request flight deck control have O_2 N_2 producing room personnel to man the 4JG circuit.

18. Before securing the pumps, log the meter reading, then stop the AvGas pump first, and then the sea water pump. Log the time both pumps were stopped.

19. In order to completely drain the aviation gasoline distribution system the piping and valves must be alined as follows:

a. **Open the three bypass valves (filter, pressure regulator, and pump).**
b. **Open the pump vent line.**
c. **Open all drain lines (filter, pressure regulator, one-way check valve, pump, and the drain line header tank top valve).**

NOTE: The filter room operator will first open the valve in the automatic water drain valve bypass line, and drain the filter sump overboard until clean fuel is observed in the bull's-eye sight glass gage. He will then secure this valve and open the line between the sump and distribution riser.

20. When the system is properly alined, order the N_2 producer room to open the main supply line to the pumproom for drain back. The pumproom operator will in turn send nitrogen to the filter room where it will be injected into the filter bypass and discharge line.

21. The pumproom operator will observe the reflex sight glass gage on the AvGas pump suction header. As soon as liquid falls below this point, he will immediately close the drawoff tank supply riser, recirculating header, and drain line header tank top valves.

22. Secure the nitrogen for the drain back by closing the supply line from the pumproom to the filter room and at the filter bypass and discharge lines.

23. After the system is drained of aviation gasoline, it is purged and charged with nitrogen as follows: Open the nitrogen supply line to the AvGas pump suction and to the recirculating line header. Purge the system until a minimum of 50 percent inertness is obtained at the most remote flight deck service station. Then charge the system to 9.5 to 10 psi and secure the N_2 valves in the pumproom. Call the N_2 production room and have the main supply line at the reducing panel secured.

24. When the piping is purged and charged, secure the system by closing all valves in the distribution piping from the aircraft service stations to the pumproom. Close all drain, recirculating, and vent lines. After the valves have been secured, record all gage readings listed below:

a. **Double-walled piping.**
b. **Tank gage reading.**
c. **Distribution piping pressure and inertness.**
d. **Cofferdam pressure.**

25. Secure the sea water system by closing all valves initially opened to pressurize the system.

26. Before leaving the pumproom secure all gear, and thoroughly clean the entire area, wiping up any oil etc., that might have leaked on the deck. Remove all oil soaked or dirty rags on departure.

CHAPTER 6

AVIATION LUBE OIL SYSTEM

The aviation lube oil system (also known as piston engine lubricating oil system) on board aircraft carriers is maintained by the aviation fuels division (V-4).

Although lube oil systems vary in some respect from ship to ship, an ABF qualified in one system can easily and quickly qualify in the operation and maintenance of other lube oil systems. These systems are intended for the stowage and distribution of reciprocating engine oils, and to supply the necessary oil for operation of the ship's catapults.

Oil for jet engines is provided in sealed cans and is handled through the supply department.

LUBE OIL SYSTEM

The aviation lube oil system is a separate, independent system composed of pumps, valves, and piping arranged to supply a ready service tank, located on the gallery deck. The main pumps take suction from the manifolds connected to the built-in tanks and discharge through a manifold to the riser supplying the service tank.

The ready service tank is provided with a hand-operated pump for supplying the flight deck station. The ready service tank supplies one station on the hangar deck by gravity flow.

Each service station outlet is provided with a hose valve and short length of oil hose with nozzles for filling the 5-gallon oil cans. A drip pan is provided at each station.

Filling connections of the flush deck type are provided on the hangar deck, port and starboard, suitable for attaching funnels of the type used when filling from barrels. These filling connections are of sufficient size to provide a free flow when five barrels are discharging at the same time.

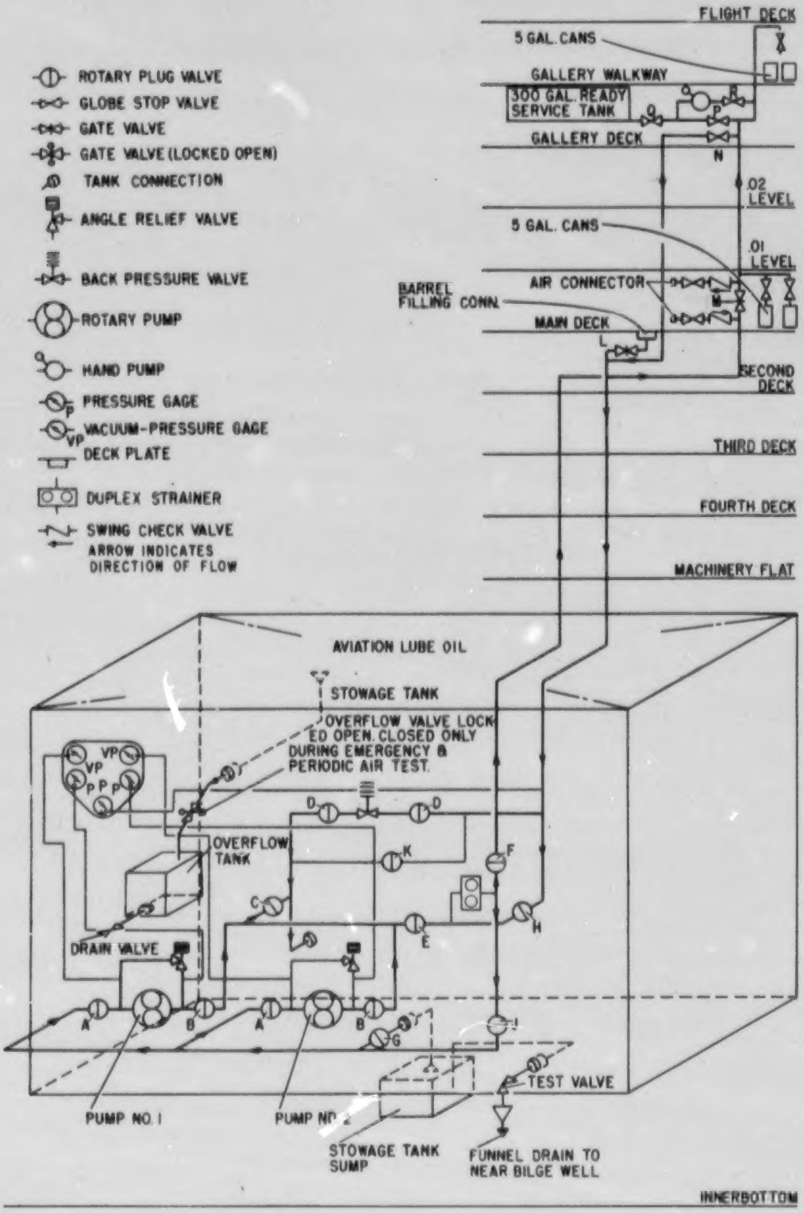
The stowage tanks are provided with steam heating coils, overflows, sampling connections, a distant reading thermometers, a tank level indicating system consisting of balanced mercury gages, and try-cocks (spaced 6 inches apart) for determining the oil level in the various tanks.

OPERATION

The piping is arranged in the pumproom so that the following operating conditions may be obtained:

1. Either or both pumps may simultaneously take suction from any stowage tank and discharge to the ready service tank or to any other stowage tank.
2. Either pump may take suction from any stowage tank and discharge to the ready service tank while the other pump is taking suction from the same (or any other) stowage tank and discharging to any other stowage tank.
3. Either or both pumps may take suction from or may discharge to the filling line.
4. Either or both pumps may take suction from the ready service tank to assist in draining the system.
5. The return mains and risers may be utilized as supply mains and risers in the event of damage, by operation of the valves in the pumproom.

Figure 6-1 is a schematic of the lube oil system.


ROTARY PLUG VALVE
GLOBE STOP VALVE
GATE VALVE
GATE VALVE (LOCKED OPEN)
TANK CONNECTION
ANGLE RELIEF VALVE
BACK PRESSURE VALVE
ROTARY PUMP
HAND PUMP
PRESSURE GAGE
VACUUM-PRESSURE GAGE
DECK PLATE
DUPLEX STRAINER
SWING CHECK VALVE
ARROW INDICATES DIRECTION OF FLOW
FLIGHT DECK
5 GAL. CANS
GALLERY WALKWAY
300 GAL. READY SERVICE TANK
GALLERY DECK
.02 LEVEL
5 GAL. CANS
.01 LEVEL
AIR CONNECTOR
BARREL FILLING CONN.
MAIN DECK
SECOND DECK
THIRD DECK
FOURTH DECK
MACHINERY FLAT
AVIATION LUBE OIL
STOWAGE TANK
OVERFLOW VALVE LOCKED OPEN. CLOSED ONLY DURING EMERGENCY & PERIODIC AIR TEST.
OVERFLOW TANK
DRAIN VALVE
PUMP NO. 1
PUMP NO. 2
STOWAGE TANK SUMP
TEST VALVE
FUNNEL DRAIN TO NEAR BILGE WELL
INNERBOTTOM
A
B
C
D
E
F
G
H
I
K
L
M
N
O
P
R
VP
P

197.58

Figure 6-1.—Schematic of the lube oil system.

Filling the Stowage Tank

To fill the stowage tank, rig the filling connection on the main deck and open valve L. (See fig. 6-1.) Open valves H and J, A and B of the desired pump suction and discharge, and valve C to the tank. Start the lube oil pump and observe conditions of filling by means of the tank level gage in No. 1 auxiliary machinery room.

The stowage tank may be filled by either of the following methods:

1. POURING FROM DRUMS. Screw a large funnel into the filling connection, raise the drum above the filling connection using a forklift or by other means, and open the large cap. The large cap should be on the bottom, near and over the funnel. Next, open the small cap on top to allow air into the drum. The amount of oil leaving the drum can be controlled by opening and closing the top cap.

2. SIPHONING FROM DRUMS. Rig a 1 1/4-inch gasoline nozzle with a brass nozzle long enough to reach to the bottom of the drum, and rig a hose from the nozzle with a fitting into the filling connection. Using this method, the vacuum from the lube oil pumps may be utilized for loading.

3. LOADING FROM A TRUCK ON THE DOCK. Rig a direct line from the truck to the filling connection. When this method is used, a pump on the truck is utilized to boost the oil from the truck to the filling connection.

CAUTION: When using method 3, use caution to insure that the pressure from the truck to the lube oil system is not enough to cause damage to hose, piping, and pumps.

When taking on lube oil, a vent is not necessary as the system is vented through the tank to the overflow tank. The valves from the tank to the overflow tank are locked open during this operation. To allow for expansion, tanks should not be filled beyond 90 percent capacity.

Pumping to Ready Service Tank

To draw oil from the stowage tank and discharge to the ready service tank on the gallery deck, use the following procedure:

Heat oil in the tank to a termperature of approximately 100° F. Open valve G from the tank and valves A and B of the desired pump suction and discharge (fig. 6-1).

(NOTE: Some ships have only one pump installed in the piston engine lube oil system.) Open valves E and F at the strainer inlet and outlet. Open rotary plug valves D on each side of the back pressure valve. Start the pump and observe conditions of operation from the tank level gage, the pump suction gage, and the discharge gage. Open valves P and Q. Conditions of filling are observed at the tank level gage on the ready service tank.

Servicing From Ready Service Tank

To serve outlets from the ready service tank with motor pumps inoperative, use the following procedures:

1. Main deck service stations. Close valve M (main deck riser) and valve N on the gallery deck. Open valves P and Q.
2. Gallery walkway service station. Close valves M and N. Open valves Q and R. Operate the hand pump located at the ready service tank.

Draining Back the System

To blow out the loop to the service tank, close valve M in the main deck riser. Open valves F, H, and K. Alternately open the air valves above and below valve M.

Securing the System

The lube oil system is secured after each operation. This is accomplished by securing all valves except M and N, the loop supply cutout valves on the main and gallery decks, the stowage tank overflow valve located in auxiliary machinery room No. 1, and the used aviation oil drain valves on the fourth deck. Prior to securing the system, insure that the ready service tank is filled.

NOTE: Complete operating instructions are contained on a board mounted in the lube oil pumproom.

CONTAMINATED LUBE OIL STOWAGE TANKS

Some contaminated lube oil drains are connected to the ship's contaminated oil stowage tanks which are maintained by the engineering department for stripping NSFO stowage and service tanks.

CAUTION: Aviation lube oil contaminated with AvGas should NEVER be put into these tanks due to the fire hazard that it presents. This type tank has no means of protection.

There are two types of protected lube oil tanks–the first is protected by displacing the air in the tank with an inert gas. This tank is usually maintained by the aviation fuels division and controlled and operated through piping and valves located in the aviation lube oil pumproom.

The second protected tank makes use of sea water to provide protection. This contaminated oil tank is initially filled with sea water from the ship's fire main. As contaminated oil is poured into the contaminated oil drain openings, it displaces the sea water overboard through an overboard discharge line. When the tank is to be emptied, sea water from the ships fire main is introduced into the tank to force the oil out through a discharge line.

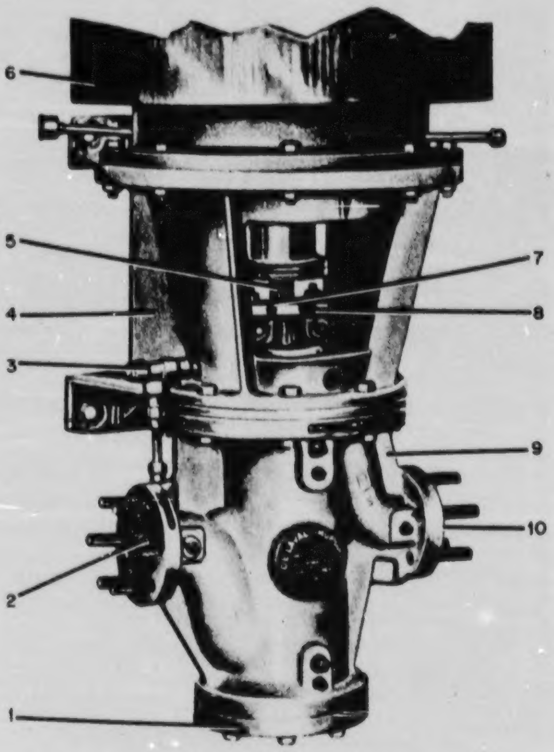
CONTAMINATION

Contamination is always a problem in aviation lube oil and a matter of great concern to the ABF. The sources to check for contaminants are the ready service outlets, ready service tanks, and the stowage tanks.

The ready service outlets should be checked each time oil is dispensed from them by first taking a small sample from the outlet and inspecting it for rust, water, and any other contaminants. If contaminants are found, the strainer to the outlet should be pulled and checked. The ready service tanks should be checked periodically, drained, and cleaned. Also, the stowage tanks should be checked before each yard availability; and if rust or other contaminants are present, it should be planned to drain and clean them during the yard period. If contamination is found at any time, the source must be checked and eliminated before oil is issued to aircraft.

LUBE OIL PUMP

The De Laval-iMO series 31P156 pump used in aviation lube oil systems is of the vertical, single stage, positive displacement, rotary, screw type. (See fig. 6-2.) The pump consists essentially of a power rotor that moves the oil, two idler rotors for sealing purposes, the housing, thrust elements, shaft packing, and piping connections.



1. Lower end cover.
2. Suction connection.
3. Relief valve.
4. Shaft housing.
5. Shaft.
6. Power unit.
7. Adjusting screws.
8. Packing gland.
9. Pump case.
10. Discharge connection.

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Figure 6-2.–Lube oil pump.

OPERATING INSTRUCTIONS

When the pump is started for the first time, or after a long period of idleness, follow the instructions for initial starting given below.

Initial Starting

All external surfaces of the pump should be carefully cleaned before the pump is started. If the factory assembly has not been disturbed, it will not be necessary to dismantle the unit for cleaning. The interior was slushed with a special rust preventive compound after the factory test. The removal of this compound is effected completely without any harmful results in the normal operation of the unit.

Insure that the shaft packing has been installed and that the gland nuts are only fingertight.

Before starting the pump, prime it by filling the pump case and as much of the suction line as possible with oil. If the air is not removed from the suction line, the performance of the unit will be erratic, or it will not pump at all. If no priming connection is provided, it becomes necessary to remove the plug on the suction connection of the pump and fill with oil.

Open the suction, discharge, and vent valves and start the motor. If the pump is moving the oil satisfactorily, the vent valve may be closed after a few minutes of operation. Allow the shaft packing to leak freely for the first 15 minutes of operation and then tighten the gland nuts with the fingers until there is only a slight leakage past the packing.

If the pump fails to discharge after starting, stop the motor, prime the pump again, and restart the pump. If it still does not pick up oil immediately, there may be a leak in the suction line, or the trouble may be traced to excessive suction from an obstruction, throttle valve, or other causes. Connecting a gage at several points along the suction line, while the pump is operating, helps locate the trouble. An obstruction in the suction line causes an observable drop in pressure at the point of obstruction, the lower pressure being on the pump side.

CAUTION: Running the pump without oil causes rapid wear of the housing and bearings; therefore checks for trouble must be made quickly and systematically.

Routine Starting

Open the suction and discharge valves and start the motor. Insure that oil is being pumped and that there is slight leakage past the shaft packing. Read the gages that indicate the suction and discharge pressures for the pump and be sure the pump is operating normally before leaving it unattended. If it is not pumping, follow the instructions for initial starting.

Running

After the pump is in service, it continues to operate satisfactorily with little or no attention. The suction and discharge pressures should be checked at least every 10 minutes to verify the performance of the pump. Once each day the shaft packing should be inspected to see that it is properly adjusted. Any unusual conditions should be noted and investigated.

Securing

Stop the motor and close the suction and discharge valves.

MAINTENANCE

De Laval-IMO pumps require very little attention in normal usage. Unless they are run without oil, or with oil containing abrasive particles, their operation without major overhaul is virtually unlimited.

The pump is equipped with a relief valve to prevent excessive oil pressure buildup. The relief valve also seals the metallic packing against air leakage during suction lift conditions. The valve should be set to maintain 15 psi on the packing box. If the pressure exceeds 15 psi, lube oil is discharged back to the suction side of the pump.

There is a set of packing located in the packing box end cover. (See fig. 6-3.) The four flexible metallic packing rings are installed with the joints of abutting rings staggered, and are held in place by a packing gland. This packing gland is split to allow packing replacement without disturbing the other elements of the

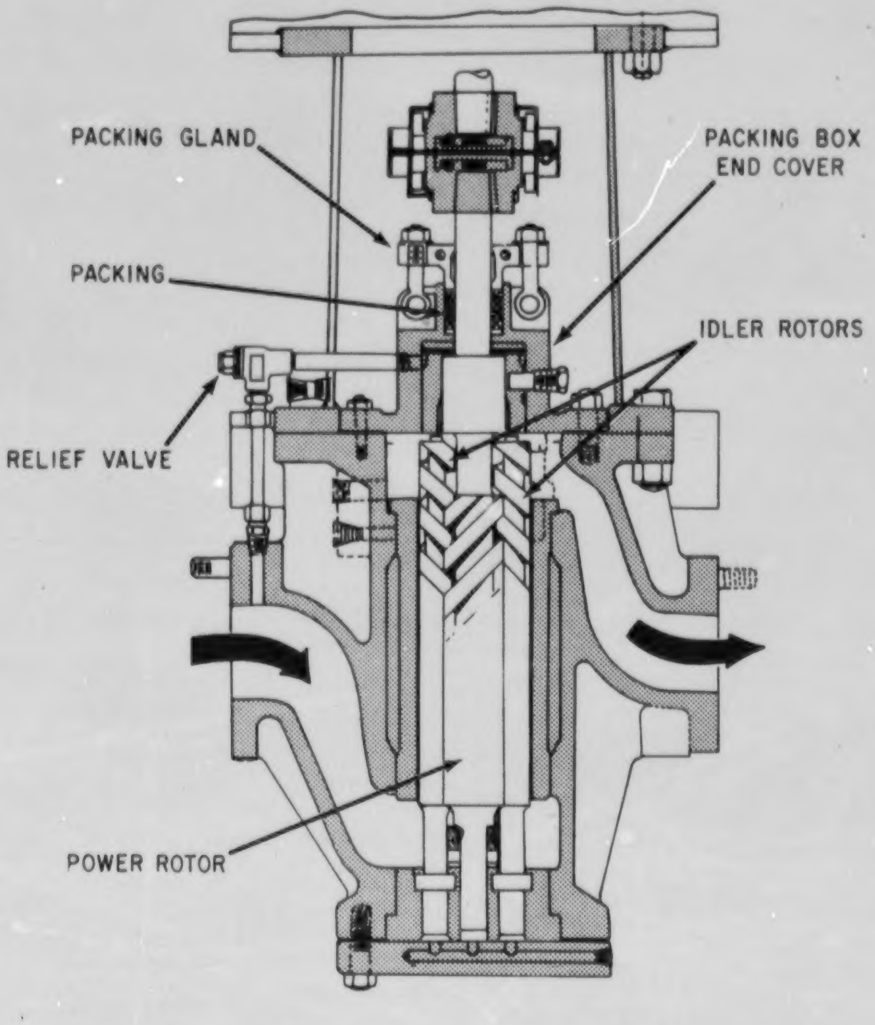

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Figure 6-3.—De Laval pump (cutaway view).

pump. The two sections of the packing gland are held together with two screws, and the gland pressure is adjusted with two gland nuts. This adjustment should be sufficient to allow a slight amount of leakage past the packing for lubrication of the packing.

Inspection

An inspection made while the pump is running discloses any leakage between the end covers and case, or in the piping connections. If leakage is observed, it may be due to foreign matter on the gaskets, defective gaskets, or loose nuts and bolts. Replace the gaskets or tighten the nuts and bolts as required.

Lubrication

The pump does not require any lubrication since the oil being pumped lubricates all the moving parts.

Driving unit lubrication instructions are provided in the driving unit instructions for each unit.

Operating Troubles

Some operating troubles may be evident from a low discharge pressure, excessive or unusual noise, or an overloaded driving unit. The following paragraphs discuss the most likely causes of operating troubles.

LOW DISCHARGE PRESSURE.–A low discharge pressure generally indicates that not enough oil is being pumped. This condition may exist because the pump needs priming, or because of leakage. A gradual decrease in discharge pressure over a period of time is generally the result of pumping oil containing abrasive particles that cause wear of the housing and rotors.

NOISE.–Excessive or unusual noises may be caused by cold oil, dirty strainers, air in the oil, vaporization of the oil due to increased temperature, or misalinement of coupling.

OVERLOADED DRIVING UNIT.–Excessive friction in the pump or in the driving unit can cause a driving unit to be overloaded. Misalinement of parts when reassembling the pump increases friction. Overloading may also be caused by faulty operation of the system, heavy or cold oil, or from other causes that are not due to actual malfunctioning of the pump.

For detailed information on the De Laval-IMO lube oil pump see Instruction Book, Aviation Lube Oil Pump, NavShips 0347-232-9000.

CHAPTER 7

FUELS DIVISION ASHORE

Since the various air stations operated by the Navy differ considerably in size, arrangement, and mission, the functional organizations of their various departments, divisions, etc., also differ considerably. Therefore, the organization and operation of fuels divisions (branches on smaller stations) vary from station to station and must be sufficiently flexible to meet differing operational requirements.

Fuel farm and fuel delivery operations are the responsibilities of the supply department. The normal petroleum operations consist of the receipt, stowage and issue of liquid petroleum products to the aircraft. These operations include the inspection and quality assurance surveillance of this fuel.

FUELS DIVISION ORGANIZATION

The organization discussed in the next few paragraphs is that of a fuels division at one of the large continental master jet complexes. As mentioned earlier, the particular organization at other stations may differ somewhat, depending on the needs of the particular station. The general organization of the division being discussed is shown in figure 7-1. (In the case of a fuels branch vice a fuels division the same basic organization shown in figure 7-1 would generally apply with the following modifications: change division to branch and branches to sections; delete fuels chief and section leaders.) It will be noted that this division is organized along its major functional lines.

At the head of this division, and having charge of all the fueling facilities and personnel, is the fuels officer. (See fig. 7-1.) Sometimes at small fuel farms he may be the supply department material officer or a chief aviation boatswain's Mate F. If a civilian, he is usually called the superintendent. He is responsible for the receipt of fuels; making the necessary arrangements for the delivery of fuels; handling the necessary accounting records; taking all steps necessary to assure himself of the quality of fuel received; insuring that all fuel operations are performed in accordance with approved safety standards; and witnessing all tank and/or compartment gages, water gages, and temperatures.

The fuels division generally consists of four branches: the mechanical operations branch; the fuels inventory control branch; the quality assurance, inspection, and training branch; and the aircraft fuels delivery branch.

MECHANICAL OPERATIONS BRANCH

The mechanical operations branch is concerned with the stowage tanks, the transfer system, and the major pumping stations and associated equipment. Most of what is generally categorized as fuel farm equipment is operated and maintained by the personnel of this branch. The maintenance performed by personnel of this branch is termed "operator maintenance" in that it is maintenance within the skill of the operator of the equipment in question. Such maintenance includes checking and testing of fueling system equipment, lubricating valves, adjusting pump glands, changing gaskets, changing filter/separator elements, etc.

General supervision over the personnel and facilities of the fuel farm are vested in the mechanical operations branch supervisor. In addition to the equipment and facilities listed

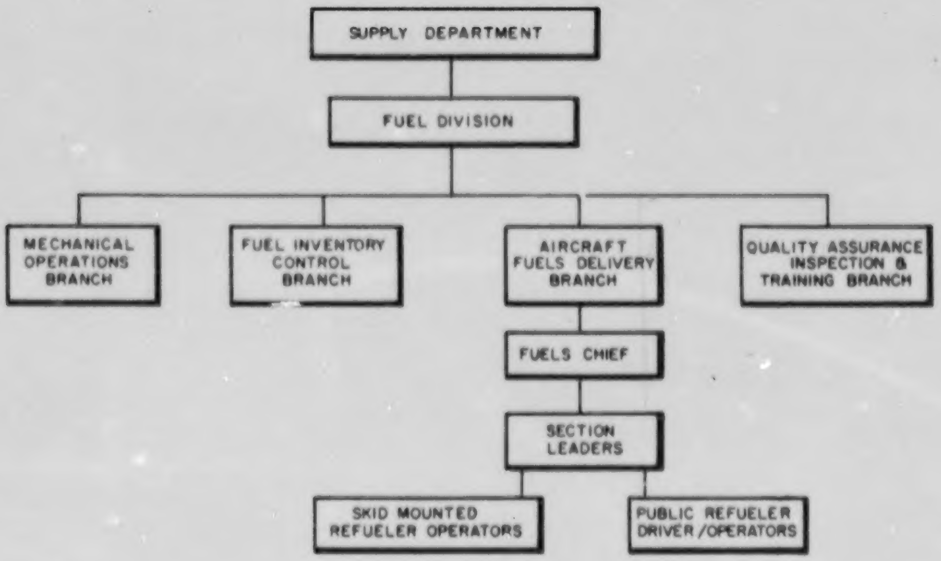
SUPPLY DEPARTMENT
FUEL DIVISION
MECHANICAL OPERATIONS BRANCH
FUEL INVENTORY CONTROL BRANCH
AIRCRAFT FUELS DELIVERY BRANCH
QUALITY ASSURANCE INSPECTION & TRAINING BRANCH
FUELS CHIEF
SECTION LEADERS
SKID MOUNTED REFUELER OPERATORS
PUBLIC REFUELER DRIVER/OPERATORS

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Figure 7-1.—Fuels division organization.

above, fuel farms include the following: wharf or truck unloading facilities; mobile refueler fill stands; and the necessary piping, valves, and pumps for fuel farm operations.

The mechanical operations branch supervisor is responsible for the satisfactory performance of daily, weekly, and monthly checks and inspections. He must see that these checks and inspections are properly entered in the required logs. These inspections cover such items as hoses, grounding cables, pumps, valves, etc. He is also responsible for maintaining good housekeeping conditions about the fuel farm and for the strict enforcement of safety regulations in his realm of operation.

Many of the general operational and maintenance procedures for fuel farms are covered in Military Standardization Handbook, Petroleum Operations, MIL-HDBK-201B.

INVENTORY CONTROL BRANCH

The fuels inventory control branch is responsible for the accounting procedures required in accounting for the fuel and lube oil received and issued by the fuel farm. All invoices and requisitions are processed through this branch.

QUALITY ASSURANCE BRANCH

The quality assurance, inspection, and training branch is responsible for the inspection and quality assurance of all fuels received or issued by the fuel farm. Fuel samples from all stages of fuel handling operations are delivered to this branch for inspection. All samples that require inspection by a petroleum laboratory are taken by this branch or they are delivered to this branch for forwarding. This branch is responsible for the checking of filter/separators and fuel monitors, and for the maintenance of pressure differential records for filter/separators and fuel monitors. This branch may also be charged with the training of new personnel in the various functions of the fuels division.

AIRCRAFT FUELS DELIVERY BRANCH

Most of the military personnel that are attached to the fuels division of the supply department are in the aircraft fuels delivery branch. The mission of this branch is to provide refueling, oiling, and defueling services for all tenant and transient aircraft and other units such as fuel test cells at the air activity. An additional significant responsibility of this branch is the performance of operator maintenance on equipment operated by branch personnel. Examples of such maintenance include testing and inspection of equipment, lubricating and adjusting valves, changing filter/separator elements and fuel monitor fuses, testing and replacing hoses, etc.

The aircraft fuels delivery branch is supervised by a chief petty officer and shift supervisors. They are directly responsible for the safe and efficient management of this branch. The fuels chief is responsible to the fuels officer for the administration of the aircraft fuels delivery branch. He acts as the supervisor of all assigned field supervisors. He insures that all required safety regulations concerning handling of liquid fuels are observed, and that immediate attention is given to correcting discrepancies noted by the quality assurance branch. This includes assurance that no vehicle or equipment that has been downed by the inspector of the quality assurance branch is operated prior to correcting the cause, unless specific approval has been received from the fuels division officer. The fuels chief's military duties are essentially the same as those given in chapter 2 of this training manual.

The training petty officer is responsible to the fuels division chief for maintaining required training records for the military personnel, submitting the required reports, and coordinating the training efforts with the fuels inspector who is responsible for the training of the division as a whole.

The dispatchers should normally be responsible petty officers. Under the supervision of the fuels chief, dispatchers are responsible for knowing the whereabouts of all drivers, dispatching refueling/defueling equipment according to schedule, and refilling all trucks as operations permit. He must insure that the dispatch sheet and the issue documents are properly filled out.

Section leaders are responsible for expediting and supervising the refueling and defueling operations and for compliance with all safety regulations. He must insure that each refueler contains the proper grade or type of fuel and that all inspections and checks are carried out on the refueler.

The maintenance petty officer coordinates the truck maintenance schedule with fueling operations and submits a daily report to the chief regarding the status of all assigned vehicles.

STOWAGE TANKS

According to function, stowage tanks for aviation fuels ashore may be placed in two categories or groups–main stowage tanks and ready service tanks. The latter are also sometimes referred to as day tanks or operating stowage tanks.

The main stowage tanks are the large tanks used for storing several days supply of fuel. Aircraft fuels are pumped into these tanks upon receipt from suppliers by tank car, truck, or barge.

To the extent practicable cargoes should be discharged into empty shore tanks. After discharging and checking for quality, identical products may be combined in common tankage. Gasoline stowage tanks should be kept as full as possible to minimize evaporation losses, which are excessive in partially filled cone roof tanks during extended storage. The probable need for empty stowage tanks for another product or contaminated cargo should be kept in mind. When stowage tanks are changed from one grade of product to another, the prescribed changeover procedure must be followed to preclude product contamination.

Separate grades and products should be segregated from one another.

Segregation of approved grades and products should be by positive means e.g. a blank flange, spectacle plate, spool piece or double valve with an open drain. Segregation by a single valve only is not sufficient.

Fuel is pumped from the main stowage tanks to the ready service tank. At some stations these tanks are referred to as "day tanks," because they were originally designed to hold approximately the amount of fuel required for a day's operation. Not all stations are equipped with such tanks, for the design features of some systems are such that they are not needed in accomplishing the mission at that particular station.

When provided, the day tank is usually a vertical steel subsurface tank. A number of deepwell fuel transfer pumps are installed through the roof of this tank. Factors which have a bearing on the number and capacity of the transfer pumps used are the size of the tank, operating pressure of the system, number of fueling stations serviced, etc.

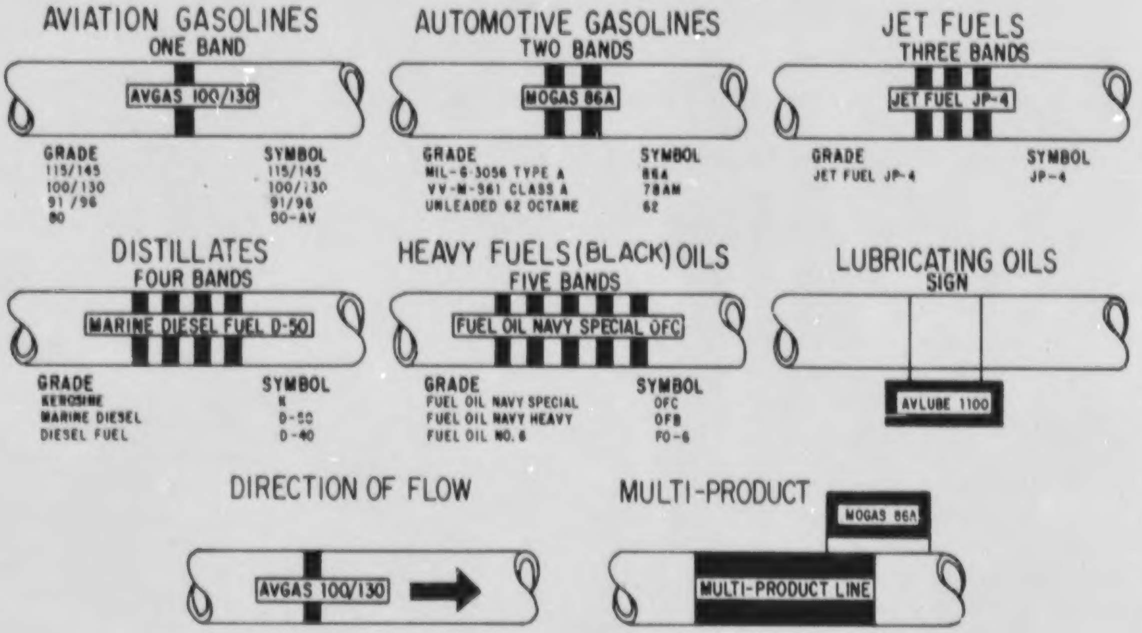
All piping systems are marked to clearly identify the grade of product being carried. These markings are placed adjacent to all operating accessories such as valves, pumps, regulators, manifolds, etc., with warnings and titles as shown in figure 7-2.

Table 7-1 lists the sizes of letters and bands used for petroleum products. MIL-STD-161 establishes a uniform method of identification of liquid petroleum products. In NATO countries the NATO symbol for the grade of product is included in the marking or identification scheme. Refer to table 7-2 for common NATO symbols. Fuels having the same NATO symbol are interchangeable. Fuels not listed as interchangeable may be used with certain restrictions; detailed information of interchangeability of NATO aviation fuels and lubricants with related specifications is contained in NavAir Instruction 10300.1A or NavShipInst 10300.10C.

REFUELING STATIONS (SKID MOUNTED REFUELERS)

The refueling stations discussed in the next few paragraphs are those used for fueling jet aircraft through use of skid-mounted refuelers. A skid-mounted refueler is a steel framework forming a skid on which is mounted filtering, metering, and dispensing equipment. These units are classified as fixed equipment rather than mobile or movable equipment. Such units are found on about 10 naval air stations. They are used extensively on master jet bases.

Each fueling station consists of one or more skid-mounted refuelers, a source or sources of


AVIATION GASOLINES
ONE BAND
AVGAS 100/130
AUTOMOTIVE GASOLINES
TWO BANDS
MOGAS 86A
JET FUELS
THREE BANDS
JET FUEL JP-4
DISTILLATES
FOUR BANDS
MARINE DIESEL FUEL D-50
HEAVY FUELS (BLACK) OILS
FIVE BANDS
FUEL OIL NAVY SPECIAL OFC
LUBRICATING OILS
SIGN
AVLUBE 1100
DIRECTION OF FLOW
AVGAS 100/130
MULTI-PRODUCT
MOGAS 86A
MULTI-PRODUCT LINE

GRADE	SYMBOL
115/145	115/145
100/130	100/130
91/96	91/96
80	80-AV

GRADE	SYMBOL
MIL-G-3056 TYPE A	86A
VV-M-561 CLASS A	78AM
UNLEADED 62 OCTANE	62

GRADE	SYMBOL
JET FUEL JP-4	JP-4

GRADE	SYMBOL
KEROSINE	K
MARINE DIESEL	D-50
DIESEL FUEL	D-40

GRADE	SYMBOL
FUEL OIL NAVY SPECIAL	OFC
FUEL OIL NAVY HEAVY	OFB
FUEL OIL NO. 6	FO-6

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Figure 7-2.—Identification method for bulk petroleum product lines.

Table 7-1.—Sizes of Letters and Bands

	Width of Bands		Space between Bands	Length of Bands	Title Letter Size
	Wide	Narrow			
a. Pipe Diameter:					
Under 3"	6"	3"	3"	encircle	½"
3" to 6"	6"	3"	3"	encircle	1"
6" to 9"	6"	3"	3"	encircle	2"
Over 9"	8"	4"	4"	encircle	3"
b. Tank Capacity:					
10,000 bbl and under	6"	3"	3"	33"	6"
Over 10,000 bbl	8"	4"	4"	54"	12"
c. Tank Car, Trucks:					
2,000 gal and under	6"	3"	3"	24"	3"
Over 2,000 gal	6"	3"	3"	33"	6"

auxiliary power for aircraft being refueled, and other equipment necessary for accomplishing the refueling operation such as grounding wires, hoses, adapters, movable stands, firefighting equipment, lighting equipment, etc.

These refueling stations are located just off of taxi strips so that aircraft returning from flights may taxi directly up to the fueling station for refueling before returning to the flight line or proceeding to the launching strip for another flight. Stations are also located so that aircraft may be conveniently towed or taxied from the flight line to the station for refueling.

The fueling of aircraft with engines idling is on the increase. The Air Systems Command approves this practice on a model by model basis after exact procedures have been worked out and thoroughly tested.

Fuel from the day tank is placed under pressure and sent via underground pipes to the various fueling stations serviced by the particular tank and piping system. At the skid mount the branch supply line from the day tank is furnished with a T- or Y- fitting and flange connection to the skid-mounted refueling unit. A return line is installed for evacuating the fuel from the refueling hose.

The fuel leaving the supply connecting flows through a strainer and a filter/separator. (Water removal is also accomplished at the day tank by filter/separators.) A monitor (go-no go gage) is located downstream of the filter/separator. (See fig. 7-3.)

The monitor provides a continuous check on the cleanness of the fuel passing through the filter/separator. Fuel that meets a predetermined standard of cleanness passes through the monitor with a minimum of pressure drop. Fuel containing quantities of solids and/or water above the predetermined acceptable level is automatically cut off.

Until cutoff is reached, the monitor traps solids and water, and passes only acceptable fuel.

The monitor consists of an aluminum housing and various numbers of fuses, depending on the model. A pressure gage, similar to the one installed on the filter, is installed for checking the pressure drop across the monitor.

Each fuse element of the monitor is a self-contained unit consisting of specially treated paper filters housed within a metallic housing and fitted with plastic end fittings (fig. 7-4). The fuse-sensing components housed within the

Table 7-2.—NATO symbols for fuels

NATO Symbol	US Military Spec. MIL-G-5572 Grades	US Commercial Spec. ASTM D-910-70 Grades
F-12	80/87	80/87
F-18	100/130	100/130
F-22	115/145	115/145
	US Military Spec. MIL–T-5624 Grades	US Commercial Spec. ASTM D-1655-72 Grades
F-40	JP-4	Jet B
F-44	JP-5	None

metallic housing absorb free or suspended water from the fuel.

Fuel from the monitor flows to the meter on the skid-mounted refueler, through the main shutoff valves, and to the hoses and nozzles. An eductor is installed to evacuate the hose upon completion of the fueling of the aircraft.

No attempt is made in this training manual to give a detailed description of the procedure followed in fueling aircraft from the island type refueling station.

Such detailed refueling procedures are normally published in locally prepared instructions or aircraft fuels manuals, along with associated safety procedures to be followed.

Some of the more important steps taken in preparing the system for fueling operations follow:

1. Ascertain that the day tank is manned and ready for operation.

2. Pressurize the system and check it for proper pressure and for leaks in all associated equipment, hoses, nozzles, etc. Correct any

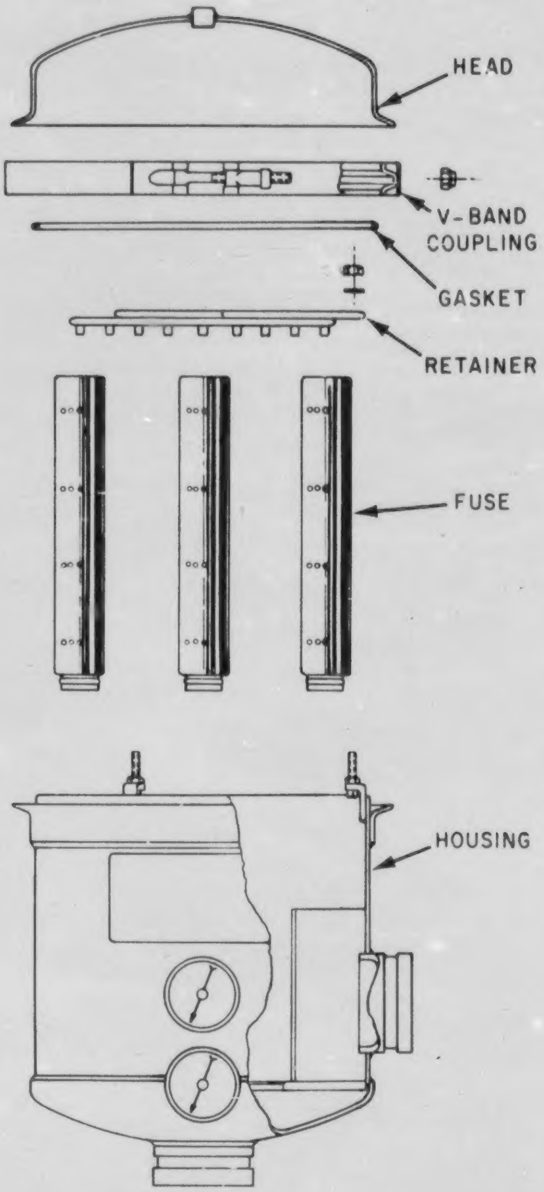

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Figure 7-3.—Fuel monitor (go-no go gage).

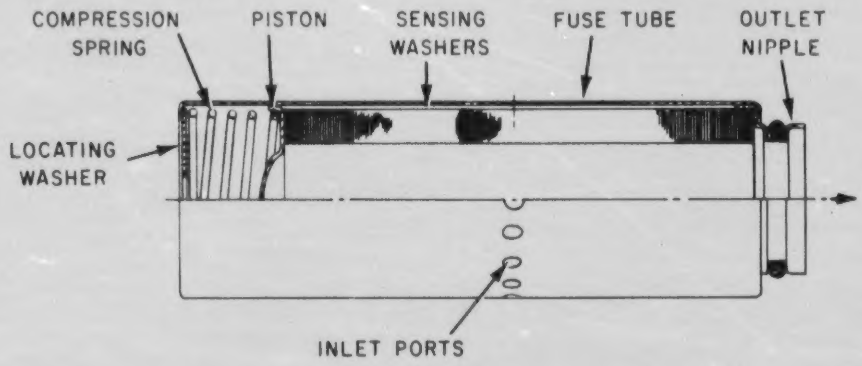

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Figure 7-4.—Fuse element.

discrepancies noted and/or report them to the proper authorities.

3. Complete daily inspections, using forms provided for this purpose.

4. At least once a day, while fuel is flowing through the refueler filter, the pressure drop across the filter elements is determined for each skid-mounted refueler. This pressure drop is determined by taking readings on the inlet and outlet sides of the filter element with the same gage. The position of the gage handle is placed parallel to the appropriate tubing for each of the two readings. Any pressure drop greater than that prescribed for the particular filter being used must be reported to the fuels division supervisor or inspector in order that the filter elements may be replaced.

Some of the advantages of fueling aircraft from the skid-mounted refueling stations are as follows:

1. Considerably more aircraft can be refueled by fewer personnel than would be possible with mobile equipment.

2. Contamination can be reduced due to fewer handling operations.

3. Aircraft can be "turned around" faster due to the speedup in refueling operations. (This advantage gave rise to the high-speed term sometimes associated with the skid-mounted refueler.)

4. Fueling operations with stations and equipment of this type are considered by many fuels specialists to be more reliable and flexible for a particular air station than is generally possible with mobile equipment.

5. The reduced likelihood of damage to aircraft by mobile equipment is also considered to be an advantage of this system of refueling.

As an indication of the versatility of the system of refueling, note the following:

1. Aircraft may be towed or taxied to and from the refueling station, thus speeding up the operation.

2. Procedures for fueling certain aircraft with their engines idling have been developed and approved. Such a fueling operation of an A4 aircraft through the probe is illustrated in figure 7-5.

FILTER/SEPARATORS

Filter/separators located at the pump discharge are designed to remove from aviation fuel 98 percent by weight of all solids, 5 microns in size or larger, and in excess of 99.9 percent of all water.

The following general operating procedures should be observed:

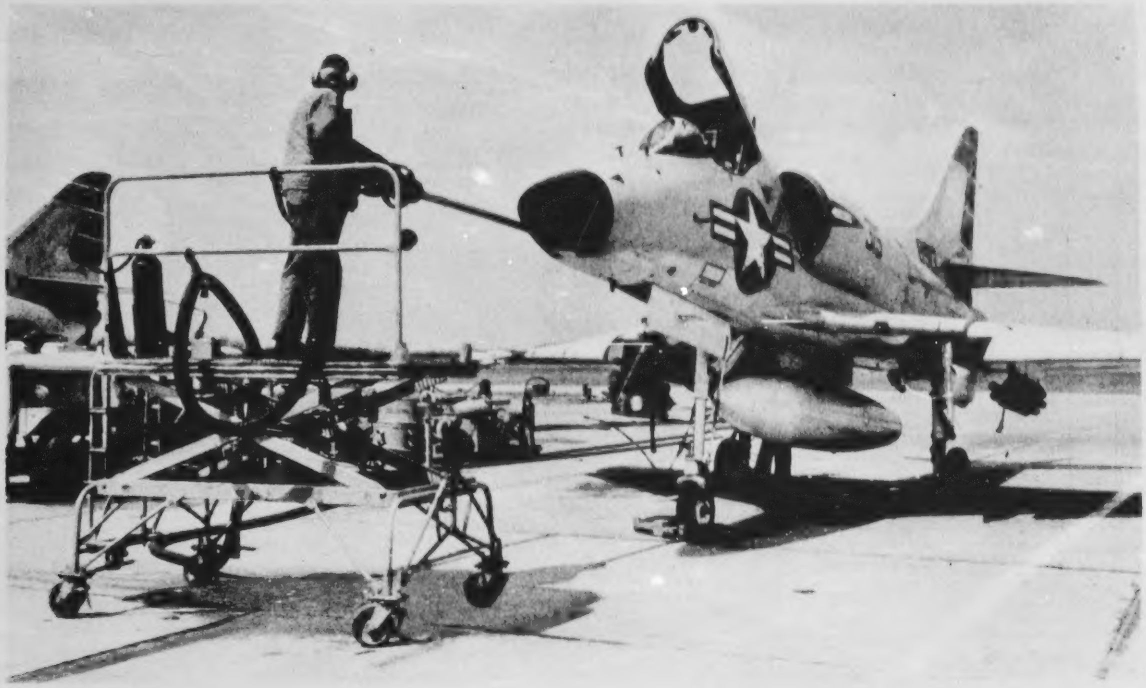

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Figure 7-5.—Probe refueling.

1. Installation of New Elements.
   a. Close nearest manual valves upstream and downstream of filter/separator.
   b. Completely drain filter/separator case.
   c. Remove old elements.
   d. Thoroughly flush out interior of filter/separator case with clean fuel.
   e. Install new elements following manufacturer's instructions. Special attention should be paid to O-ring and other type seals.
   f. Install new head gaskets or seals as required.
   g. Secure case head. (CAUTION: Uneven tightening of head bolts may result in leakage. Use only recommended torque.)
   h. Slowly fill case. Be sure case is vented during filling and all air is eliminated prior to starting circulation. Observe for possible leakage.
   i. Start flow at reduced flow rate. Circulate fuel. Take frequent samples downstream of filter/separator. Make visual inspection until a bright clear sample is observed. It is suggested that a minimum of 1,000 gallons be circulated through the filter/separator before fuel is dispensed to aircraft.
   j. Observe and record pressure drop across filter/separator. Pressure drop must be read at normal operating pressures and flow rate of the filter/separator. Stencil date of new element installation on exterior of filter/separator case.

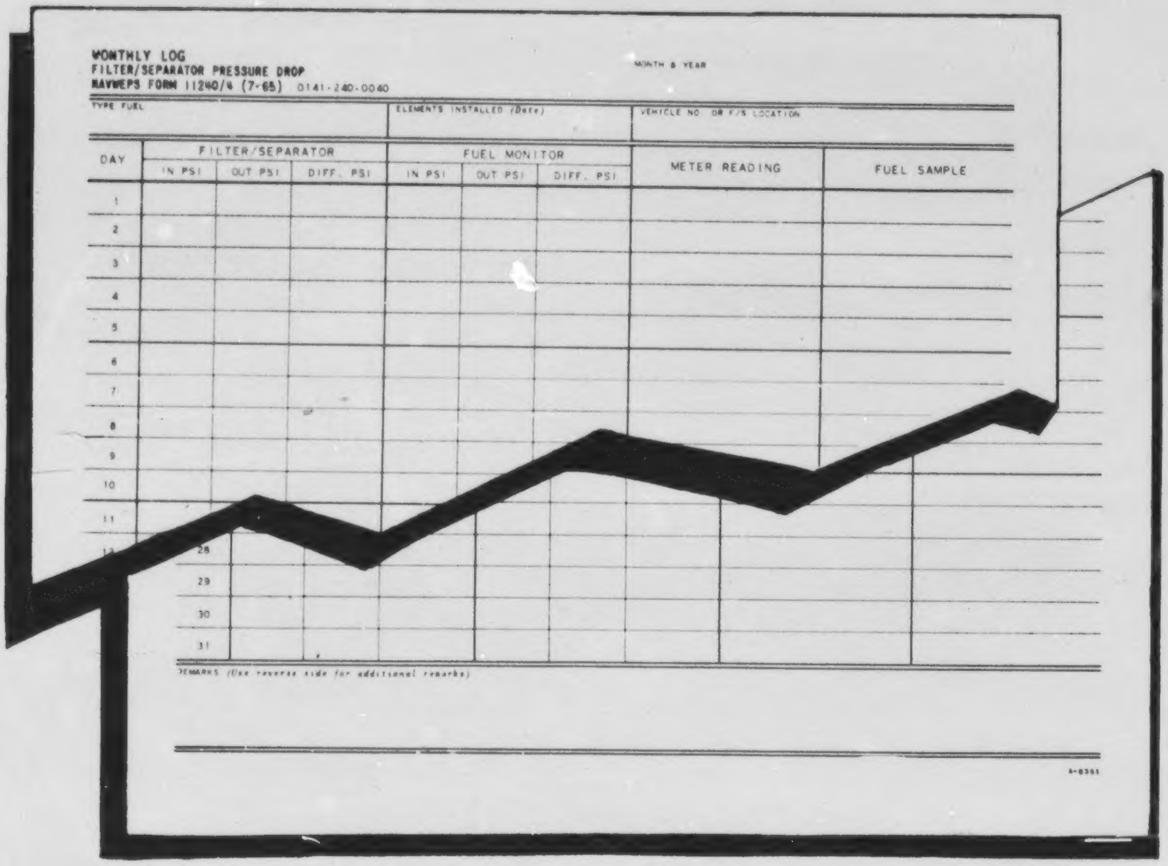
2. Operations.

a. Daily, drain low point drains on filter/separators and sample for presence of water. If water is observed, continue to drain until a water-free sample is obtained.

b. Daily, under full-flow conditions, take representative fuel samples from both upstream and downstream of the filter/separators. The samples should be taken in clean, clear, glass containers, a minimum of 1 quart in size. The samples should be inspected in a good light and observed for acceptable appearance of clean, bright, and water-free fuel.

The observed quality of the fuel sample together with the pressure drop is to be recorded on Filter/Separator Log, NavWeps Form 11240/4. (See fig. 7-6.) If system design permits, meter readings showing quantity of fuel processed through a filter/separator should also be recorded in appropriate space on the log.

c. Rated fuel flows must not be exceeded. Operating pressures must be held to a minimum consistent with flow requirements. Operating



MONTHLY LOG
FILTER/SEPARATOR PRESSURE DROP
NAVWEPS FORM 11240/4 (7-65) 0141-240-0040

MONTH & YEAR

TYPE FUEL

ELEMENTS INSTALLED (Date)

VEHICLE NO. OR F/S LOCATION

DAY	FILTER/SEPARATOR			FUEL MONITOR			METER READING	FUEL SAMPLE
	IN PSI	OUT PSI	DIFF. PSI	IN PSI	OUT PSI	DIFF. PSI		
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
28								
29								
30								
31								

REMARKS (Use reverse side for additional remarks)

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Figure 7-6.—Filter/Separator Log, NavWeps Form 11240/4.

procedures that would result in pressure surges must be avoided.

d. Reverse flow through filter/separators is not permitted.

e. All gages used for indicating pressure drop are to be calibrated at least every 6 months. Date of gage calibration should be entered on filter/separator log.

f. All operating procedures must be consistent with applicable safety requirements.

3. Element Change Requirements. The following criteria govern element change requirements.

a. The elements in systems equipped with a filter/separator without a fuel monitor are required to be changed after 1 year or when there is a pressure drop of 15 psi across the filter/separator, whichever occurs first.

b. The elements in systems equipped with a filter/separator and a monitor down stream of the filter/separator are required to be changed after 2 years or when the pressure drop across the filter elements reaches 20 psi, whichever occurs first.

c. The elements in the combination go-no go gage/filter water separator, where a fuel monitor is installed in the filter/separator case, must be changed if the pressure drop exceeds 25 psi.

Figure 7-7 shows the location of elements installed in the combintaion go-no go gage/filter water separator.

Increase in pressure drop should be gradual. A sudden increase of outlet pressure indicates a malfunction in the elements and should be immediately investigated. Extreme care should be exercised in handling and disposing of old, fuel soaked elements. Inhalation of fuel fumes and contact of bare skin with fuel should be avoided. Except under an extreme emergency (such as operating in a combat area and new elements not being immediately available), elements once removed from filter/separators, regardless of the previous length of service, must not be reused, and must always be replaced with new unused elements.

MOBILE REFUELERS

Mobile refuelers are used to transport fuel from the station truck fill stands to the aircraft and then to meter it into the fuel stowage system of the aircraft through filtering and water separating equipment. Both truck-chassis-mounted and semitrailer-mounted equipment are used in this service; however, only the chassis-mounted refuelers are discussed in this manual, as this is the equipment presently in use by the Navy.

A general view of the 5,000-gallon truck-mounted aircraft refueler found on naval air stations is shown in figure 7-8. A closeup of the hose reels, meters, gages, controls, etc. for this truck is shown in figure 7-9.

Figure 7-10 is a piping schematic of a commonly used refueler.

The refueler consists of a 5,000-gallon capacity, one-compartment tank with baffle plates installed, mounted on a commercial truck. It is designed for refueling aircraft by means of a power-takeoff-driven pumping system. The pumping system is composed of a pump, a filter/separator, a fuel meter, a monitor, discharge nozzles, and the required controls for fueling operations. Fuel can be pumped from the discharge hoses into the aircraft or from the aircraft back into the refueler for defueling purposes.

A pump driven by a power takeoff from the truck transmission is located beneath the tank. The pump delivers fuel through the filter/separator to prevent water and foreign particles from entering the aircraft fuel tank. The manual water drain valve in the bottom of the separator is used to drain excessive water from the filters.

The monitor is a fuel transfer monitoring device located downstream from the filter/separator. It also traps and retains solid contamination and absorbs undissolved water passed by the filter/separator. This fuel monitor

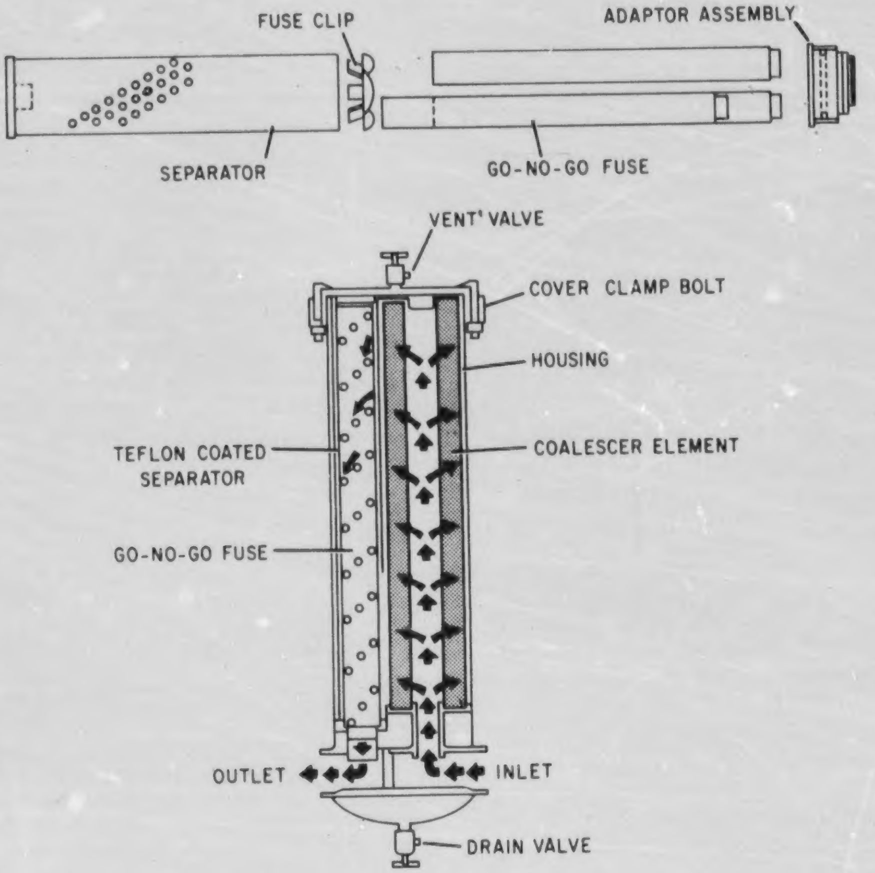
FUSE CLIP
ADAPTOR ASSEMBLY
SEPARATOR
GO-NO-GO FUSE
VENT VALVE
COVER CLAMP BOLT
HOUSING
TEFLON COATED SEPARATOR
COALESCER ELEMENT
GO-NO-GO FUSE
OUTLET
INLET
DRAIN VALVE

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Figure 7-7.—Location of elements for combination filter.

(go-no go gage) may be independent of the filter/separator, with the go-no go fuses mounted in a separate casing down stream of the filter/separator, or it may be a combination go-no go gage/filter water separator as shown in figure 7-7.

The main control valve is mounted to the outlet flange of the filter/separator and is operated by a dead-man control valve (three-way valve) to govern flow of fuel, through the system. Throttle valves are installed in the fuel lines to control direction and fuel flow. An emergency valve is installed to control the output from the tank in cases of emergency. Eductor valves are used to reverse flow direction with existing pumping system pressures when evacuating the hoses. Fuel enters and is recorded in the meters for all fueling and hose evacuation operations. Total gallonage is shown on the top-mounted counter. Two motor-driven top wind hose reels are adaptable to accomodate 1½-inch and 2½-inch diameter hoses. Overwing and pressure discharge nozzles are provided to dispense and control the fuel flow into the aircraft.

Detailed information on the operation, service, and repair of this particular refueler may be found in the Technical Manual, 5,000-Gallon

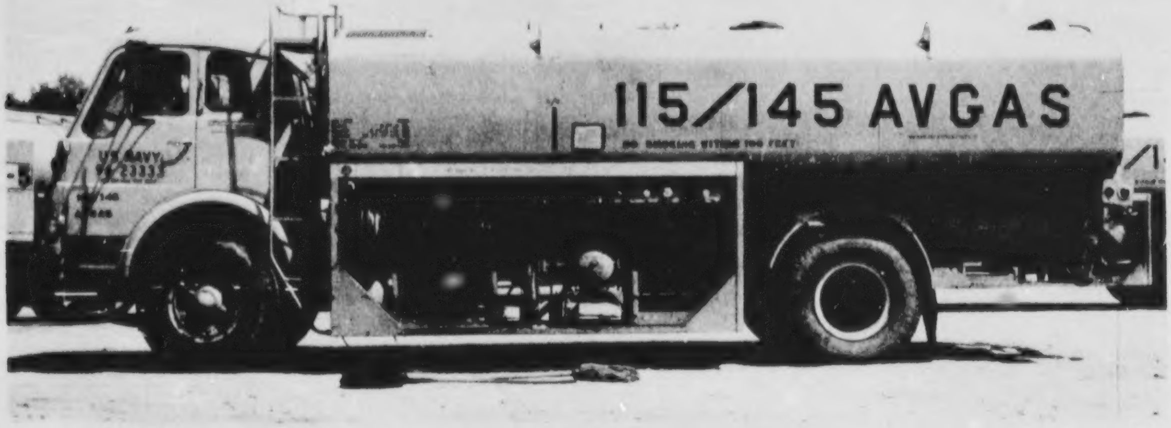

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Figure 7-8.—5,000-gallon truck-mounted aircraft refueler.

Truck Mounted Refueler, NavWeps 19-25C-15. Similar information on still later refuelers of this type may be found in NavWeps 19-25C-16. Later fuel trucks of this type purchased by the Navy incorporate certain features not found on the earlier trucks. Of particular interest is the bottom loading provision found on the latest trucks. By means of matched valves the major valve for receiving fuel on trucks with the bottom loading provision prevents the loading of the wrong fuel into the truck. Other advantages of the bottom loading feature are the turbulence and the resultant generation of static electricity can be reduced, trucks can be filled more quickly resulting in a reduction in the turnaround time, there is less likelihood of introducing foreign material into the tank due to the location and size of the tank opening, and there is less danger of injury to personnel who would normally be crawling or walking around on top of the truck tank during filling operations.

Two men are required for the proper and safe operation of this refueler when servicing an aircraft. Additional required personnel include the plane captain and fire watch who are usually squadron or flight line personnel. The refueler driver is responsible for the proper positioning of the refueler, grounding of aircraft and refueler, and operation of fueling controls on the refueler. Senior ABF's should emphasize the importance of making the proper approach to the aircraft with refuelers to avoid damage to the aircraft and equipment in case of brake failure, etc. For similar reasons and the possibility of fire, the actual position of the refueler during fueling operations is important.

The plane captain of the aircraft being refueled is usually the person who connects the fueling nozzle to the fueling point being used. An additional man should serve as fire watch, standing by with the approved firefighting equipment provided for this purpose.

The refueler driver insures that water sumps on aviation fuel truck tanks are drained at least once daily, or more often if indications of contamination are found to be present. If such is the case, all trucks are suspected and must be given additional drain checks.

The refueler driver must be certain that the aircraft is properly located away from all possible sources of ignition. If not, refueling MUST BE DELAYED until the aircraft is moved or the ignition sources eliminated.

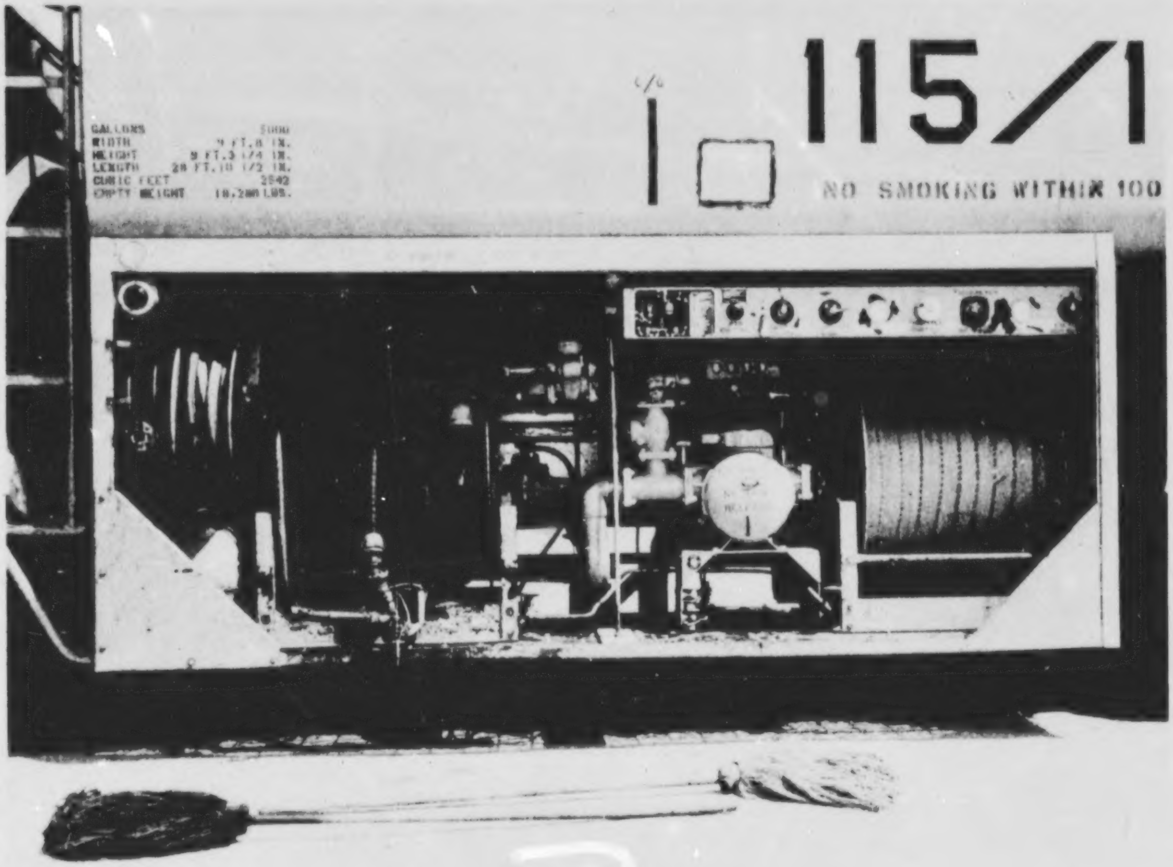

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Figure 7-9.—Hose rack and meter compartment on 5,000-gallon refueler.

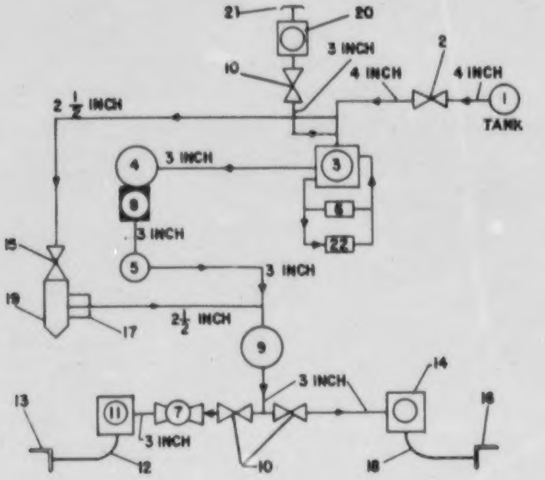
The refueler driver must park the refueler as far from the aircraft to be filled as the hose will permit. It should be parked in a position so that it may be quickly driven away. There must be no obstructions in front of the refueler to prevent its being driven away in an emergency.

After parking the refueler, set the handbrake and turn off the lights and any other electrical equipment.

The driver must make certain that the fuel in the refueler is the correct grade and type required for the aircraft.

FUELS INVENTORY AND ACCOUNTING PROCEDURES

Aviation fuels are received by fuel branch personnel of the station supply department from a refinery that bid for and was awarded the contract to supply fuel to the air station for a specified period of time. The fuel is put into underground stowage tanks and must be allowed to settle for a prescribed length of time before being used. Prior to receiving and stowing fuel, the tank(s) intended for stowage must be



1. 4-inch emergency valve.
2. 4-inch gate valve.
3. Pump
4. Filter/separator.
5. Go-no-go gage.
6. Valve-pressure control.
7. 3-inch venturi.
8. 3-inch control valve.
9. 3-inch meter.
10. 3-inch gate valve.
11. Hose reel—LH.
12. 2 1/2-inch hose.
13. 2 1/2-inch nozzle.
14. Hose reel—RH.
15. 3-inch throttle valve.
16. 1 1/2-inch nozzle.
17. 2 1/2-inch check valve.
18. 1 1/2-inch hose.
19. 2 1/2-inch eductor.
20. 3-inch strainer.
21. 3-inch pipe plug.
22. Relief valve.

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Figure 7-10.—Piping schematic for 5,000-gallon mobile refueler.

inventoried to determine how much fuel can be stowed in each tank, and to determine the total amount of fuel that can be received.

Each tank has an access above ground to permit measuring the amount of fuel in the tank. A gage calibrated in feet and inches is used for taking this reading. The reading is then converted to gallons by reference to a conversion chart; the chart also lists the total capacity of each tank. Thus fuel remaining at monthly inventory time, and fuel needed for replenishment, are easily determined.

In the next few paragraphs the issue documents used in the accounting procedures for aviation fuels at one master jet base are discussed. While the forms used at other bases may differ slightly, the basic functions are the same and the procedures followed are very similar.

Issue of fuel and lubricating oil is recorded by the refueling branch personnel on either a DD Form 1348 or on a special form issued by the station supply department. The plane captain or other authorized personnel should verify the gallons recorded on the form with the refueler meter reading. On the first working day of the week (or as directed by local authority), a DD Form 1348 for each type or grade of fuel and lubricating oil to cover the estimated requirement for the succeeding week should be filled out and submitted to the fuels division inventory control branch, by the squadron or the station operations department. At the end of each week, the estimated quantity on the DD Form 1348 will be adjusted to the actual amounts used.

All transient government aircraft refueling should be recorded on the DD Form 1348 carried in the aircraft flight packet. The form is then forwarded to the inventory control branch for preparation of an invoice for financial accounting.

Allotment credit can be allowed for fuel defueled from an aircraft when it is determined that the fuel is not contaminated. No credit can be allowed for contaminated fuel.

Civilian aircraft may be refueled and the fuel recorded in the same manner as Navy aircraft when the aircraft are under Navy contract and funds have been deposited in advance. Civilian aircraft that have made an emergency landing at the station may be refueled when authorized by the operations officer or operations duty officer stating that an emergency exists. Issues to civilian aircraft other than those under emergency conditions must be approved in writing by the commanding officer.

SUMMARY

In summary, it will be noted by ABF's who have had aircraft carrier duty that the fueling operations ashore are quite similar to those aboard ship. The functions are basically the same but the problems are a little different, being more pronounced for certain phases of the refueling operation. Many of these problems are made more acute due to the sprawling area covered by fuels operations ashore and the many chances for introducing foreign or contaminating materials into the fuel.

Some of the problem areas that will require special attention from senior ABF's are quality assurance surveillance; the close supervision and training of new personnel; an effective safety program; preventative maintenance and proper use of equipment; cheerful cooperation with civilian personnel of the fuels division; and good work management practices among personnel of the division.

Problems in work management have plagued the fuels division for years, particularly the aircraft fuels delivery branch. Many different solutions have been tried, with varying degrees of success, depending very largely on the serious thought and effort going into the planning and execution of the plans to solve these problems.

Information on oil service equipment may be found in ABF 3 & 2, NavPers 10301-C. A considerable amount of information on operational procedures and safety procedures is contained in the Handbook, Aircraft Refueling for Shore Activities, NAVAIR 06-5-502. This Handbook is updated periodically and reissued as a revised Handbook.

CHAPTER 8

QUALITY ASSURANCE AND SURVEILLANCE

The performance of any aircraft depends on the quality of the fuel that is used in it. As a leading fuels petty officer, the quality of the fuel depends on your constant vigilance in the inspection of the fuel samples and operation of the purification equipment. The fuels petty officer should have an understanding of the properties and characteristics of aviation fuels to aid him in quality assurance and surveillance. This subject is covered in detail in ABF 3 & 2, chapter 4, which should be reviewed in conjunction with the study of this chapter.

CONTAMINATION IN AVIATION FUEL

There are several forms of contamination in aviation fuels. The higher the viscosity of the fuel, the greater is its ability to hold contamination in suspension. For this reason, jet fuels having a high viscosity are more susceptible to contamination than aviation gasoline. JP-5 is more susceptible than JP-4 for the same reason.

Some forms of contamination may be detected visually, but particles large enough to be visible should rarely be present. It is said that any sediment that can be seen is too much. If a fuel sample is swirled vigorously and allowed to settle in a clean quart bottle, the sediment should gather in the bottom center and be no more than a slight smudge. Some of the forms of contamination are: water, foreign particles, and commingling.

WATER

Water can be present in the fuel in two forms—dissolved water and visible free water. Dissolved water is usually present in any petroleum product and cannot be avoided. It is allowable up to the point of saturation. The saturation point is when the fuel will hold no more water in solution. This point varies with the temperature. A warm fuel will have a higher saturation point than cool fuel. When the warm fuel is cooled, the dissolved water partly precipitates out, forming a light cloud or emulsion.

The fuel can be cloudy for other reasons, and clouds must be identified where possible. Clouds caused by water are identified by use of the AEL Free Water Detector, Mark I. When used by trained and experienced operators, this device can determine the free water content accurately to one or two parts per million. Fuel containing more than five parts per million of free water must not be delivered to the aircraft fuel tank. Water may be either saline or fresh water. Salty water is particularly hazardous to the engine and fuel system components since it can cause corrosion. Free water can cause icing of the fuel system, usually in the aircraft boost pump screens and low pressure filters. Fuel gage readings may become erratic because the water electrically shorts the aircraft fuel cell quantity probe. Gross (large) amounts of water can cause a flameout of the engine.

Water in the bottoms of aircraft fuel tanks promotes microbiological growth which in turn clogs filters, fouls fuel quantity probes, and causes fuel control malfunctions.

FOREIGN PARTICLES

Most foreign particles are found in the fuel as sediment. This can be almost any material with which the fuel comes into contact. The most common types are rust, sand, aluminum and magnesium compounds, brass shavings, rubber, talc from the interior of fuel hoses, and microbiological growth.

Rust is found in two forms–red rust (Fe_2O_3) which is nonmagnetic, and black rust (Fe_3O_4) which is magnetic. They appear in the fuel as red or black powder, rouge, or grains. In powder form it may resemble a dye. Sand or dust appears in the fuel in a crystalline, granular, or glass-like form.

Aluminum or magnesium compounds are found in the fuel as a form of white or gray powder or paste. This powder or paste becomes very sticky or gelatinous when water is also present. Brass is found in the fuel as bright gold-colored chips or dust. Rubber appears in the fuel as fairly large black irregular bits.

When a new or dried out hose is placed in service, a discoloration of fuel takes place. This is due to a chemical that is added to synthetic rubber to make it pliable. To prevent this substance from entering an aircraft, cap one end of the hose, fill with fuel, cap the open end, and allow fuel to stand for one week. Drain and flush, then continue this procedure until no discoloration can be detected. Small amounts of talc may be released from the inside surface of the fuel hose due to stretching and flexing during normal handling.

All of the above forms of contamination can cause sticking or general malfunctions of the fuel controls, flow dividers, pumps, and nozzles.

The sediment contamination of the fuel delivered to aircraft must be no more than 2.0 milligrams per liter (mg/l.) If operational necessities dictate, the command may authorize utilization of fuel contaminated above 2.0 mg/l. It should be realized that such fuel will adversely affect the aircraft fuel system reliability.

Fuel systems reliability predictions relative to sediment contamination levels are shown in table 8-1.

COMMINGLING

Unintentional mixing of petroleum products can result in fuels that may be dangerous in unprotected shipboard stowage and unacceptable in performance for aircraft. This type of contamination can generally be detected only by specific laboratory tests.

Table 8-1.–Sediment contamination level

Sediment (mg/1)	Fuel Contamination	Predicted reliability
0-1	Clean	Excellent
1-2	Slight	Good
2-5	Moderate	Fair
5-10	Heavy	Poor
Over 10	Gross	None

NOTE: A complete list of the names and addresses of the petroleum testing laboratories can be found in NAVAIR Instruction 10340.3.

Contamination of aviation fuels with other products should not exceed the amounts given in table 8-2. Aviation gasoline containing more than 0.5 percent, by volume, of jet fuel may be reduced below the allowable limits in knock rating. Contaminated aviation gasoline can be downgraded to motor gasoline, but JP-4 jet engine fuel which does not meet the required specifications generally cannot be downgraded for any other use. Off-specification JP-5 can be used as diesel or boiler fuel.

MICROBIOLOGICAL GROWTH

This growth is produced by various forms of organisms which live and multiply at the interface between fuel and water in fuel tanks. These organisms may form a slime similar in appearance to the deposits found in stagnant water. In fuel the color of this slime growth can be red, brown, gray, or black. The organisms feed on the hydrocarbons that are found in fuels, but they need free water in order to multiply.

There are two types of growth that are usually the source of the most trouble in Navy fuels–sulfate reducing bacteria and brown "hormodendron" fungus. The sulfate reducing bacteria cause trouble when they grow in the bottoms of stowage tanks which contain water and sludge. These bacteria give off hydrogen sulfide which bubbles up into the fuel and causes it to become corrosive. The fuel will no longer pass the copper corrosion test. This

Table 8-2.—ALLOWABLE CONTAMINATION WITH OTHER PRODUCTS

Product Being Handled

CONTAMINATING PRODUCT	80/87	100/130	115/145	JP-4	JP-5
80/87		0.5%	0.5%	5.0%	0.0
100/130	5.0%		0.5%	1.0%	0.0
115/145	5.0%	Any percentage acceptable		1.0%	0.0
JP-4	0.5%	0.5%	0.5%		0.0
JP-5	0.5%	0.5%	0.5%	10.0%	
Diesel or Navy distillate	0.5%	0.5%	0.5%	2.0%	0.5%
Navy Special Fuel Oil	0.0	0.0	0.0	0.0	0.0

phenomenon usually occurs with fuel stowed for several months in warm climates. This type of microbiological growth is controlled by cleaning the tanks to remove sludge and eliminate water in tank bottoms.

The brown fungus may grow in stowage tank bottoms but is not a source of trouble there. If free water, particularly sea water, is carried over into aircraft tanks, the brown fungus tends to grow in aircraft fuel tanks in a thick mat which can break loose and cause trouble in the fuel control, flow dividers, filters, or quantity gage probes. The fungus may also cause corrosion of tank bottoms. Removal of accumulated growth from tanks is difficult, time consuming, and expensive. The best method of preventing fungus growth is to keep the free water content of the fuel below five parts per million.

CONTAMINATION DETECTION

Contamination detection in aviation fuel begins with the refinery and ends after it is used. Each time the fuel is moved from one stowage tank to another it is subject to new and more contamination. If checks are not made before transfer, and appropriate stripping of settled water and sediment accomplished, the contamination already in the fuel can contaminate the new stowage.

Once contamination is detected, the fuel should not be used or transferred until it is determined that the contamination is within specified limits. Stop the transfer from one stowage tank to another, from a tanker to an aircraft supporting ship, or from a ship's system or refueling pit to an aircraft as soon as the contamination is detected. If for any reason it is thought that contaminated fuel has been put into an aircraft, the appropriate person in charge should be notified.

For each of the fuel contamination problems, there is a solution. However, equipment must be properly operated and sampling procedures carefully followed. The most important factor in delivering clean, bright, and water-free fuel to the aircraft is the integrity of the men handling the fuel.

VISUAL INSPECTION

Coarse contamination can be detected visually. The major criterion for contamination detection is that the fuel be clean, bright, and contain no perceptible free water. Clean means the absence of any emulsion, readily visible sediment, or entrained water. Bright refers to the shiny appearance of clean, dry fuels. Free water is indicated by a cloud, haze, or a water slug in the sample bottle.

Sediment in the fuel is visible when the particles are 40 microns or larger in size. A micron is 1/10,000 of a centimeter, or approximately 1/25,000 of an inch. Groups of particles less than 5 microns in size may be seen in the fuel when viewed at a right angle to a strong light. When inspecting a fuel sample, it should be swirled and allowed to settle for a few moments. The coarse particles will settle to the bottom center of the bottle and collect in a group. Any sediment that can be seen is too much for aircraft use.

The AEL Free Water Detector should be used to determine the presence of free water above the allowable limit (for aircraft) of five parts per million. Free water at this level of contamination may or may not be visible to the naked eye.

Fuel that is contaminated by commingling with another petroleum product is difficult to detect visually. In gasoline, if the percentage of the other petroleum is fairly high, there may be a color change. JP-5 contaminated by JP-4, or vice versa, can be detected by a laboratory test for flash-point and distillation. JP-5 contaminated with NSFO (Navy special fuel oil) may be visually apparent. One part of NSFO in 300 parts of JP-5 will turn the JP-5 black, or the color of strong coffee; however, some JP-5 fuels are naturally dark in color. Aviation fuels that are suspected of contamination by another petroleum product should be sent to a petroleum laboratory for inspection.

For a complete listing of the types of contaminants and their acceptable limits, refer to table 8-3.

Soundings

Liquid level indicators will only indicate the amount of fluid in a tank. They do not indicate the amount of water that may be present. Tanks can be gaged fairly accurately by the use of sounding tapes. These tapes, when used with water detecting paste, will give the depth of water in the tank. To find the amount of fuel in the tank, convert the water reading from inches to gallons and subtract the water reading in gallons from the number of gallons of liquid in the tank. Finding the amount of water in the tank will also give an indication of the amount of time required to strip the water from the tank bottom. Afterward, the paste can be used to find the effectiveness of the stripping operation.

Water entrained in the fuel will also be indicated by spots of color change on the tape. When these spots are found, the fuel should be given more time to settle before being transferred.

LABORATORY SAMPLES AND REPORTS

Sampling

Proper sampling of petroleum products is as important to quality surveillance as proper testing. Improper containers or poorly drawn samples can cause laboratory results to be meaningless, or worse, misleading.

Directions for sampling cannot be made sufficiently explicit for all cases. Judgment, skill, and experience must supplement any instructions. For these reasons, the person assigned to take samples should be trained, experienced, competent, and conscientious. The responsibility for taking and preparing samples should not be lightly delegated.

Some cardinal rules in sampling are:

1. The sampler's hands or gloves should be clean.

2. Sample containers should be meticulously clean. They should be thoroughly cleaned and inspected prior to use. Prior to

Table 8-3.—Visual Contamination Table

TYPE CONTAMINANTS	APPEARANCE	CHARACTERISTICS	EFFECTS ON AIRCRAFT	ACCEPTABILITY LIMITS FOR DELIVERY TO AIRCRAFT
A. WATER				
(1) Dissolved Water	Not visible.	Fresh water only. Precipitates out as cloud when fuel is cooled.	None unless precipitated out by cooling of fuel. Can then cause ice to form on low pressure fuel filters if fuel temperature is below freezing.	Any amount up to saturation.
(2) Free Water	Light cloud. Heavy cloud. Droplets adhering to sides of bottle Gross amounts settled in bottom.	Free water may be saline water or fresh water. Cloud usually indicates water-in-fuel emulsion.	Icing of fuel system—usually low pressure fuel filters. Erratic fuel gage readings. Gross amounts of water can cause flame-outs. Salt water will cause corrosion of fuel system components.	Zero--Fuel must contain no visually detectable free water.
B. PARTICULATE MATTER				
(1) Rust	Red or black powder, rouge, or grains. May appear as dye-like material in fuel.	Red rust (Fe_2O_3)—nonmagnetic Black rust (Fe_3O_4)—magnetic Rust generally comprises major constituent of particulate matter.	Will cause sticking, and sluggish or general malfunction of fuel controls, flow dividers, pumps, nozzles, etc.	*Refer to NOTE 1

*NOTE 1:

Particles large enough to be visible should rarely be present. At the most, the total sediment should be a spot of silt. If any appreciable contamination, is found, the test must be repeated. When testing with the AEL MK III the max is 2 mg/1.

Table 8-3.–Visual Contamination Table (Cont'd)

TYPE CONTAMINANTS	APPEARANCE	CHARACTERISTICS	EFFECTS ON AIRCRAFT	ACCEPTABILITY LIMITS
B. PARTICULATE MATTER (Cont'd)				
(2) Sand or Dust	Crystalline, granular or glass-like.	Usually present and occasionally constitutes major constituent.	Will cause sticking, and sluggish or malfunction of fuel controls, flow dividers, pumps, nozzles, etc.	*Refer to NOTE 1
(3) Aluminum or Magnesium Compounds	White or gray powder or paste.	Sometimes very sticky or gelatinous when wet with water. Usually present and occasionally represents major constituent.	Will cause sticking, and sluggish or general malfunction of fuel controls, flow dividers, pumps, nozzles, etc.	*Refer to NOTE 1
C. MICROBIOLOGICAL GROWTH	Brown, gray, or black. Stringy or fibrous.	Usually found with other contaminants in the fuel. Very light weight; floats or "swims" in fuel longer than water droplets or solid particles. Develops only when free water is present.	Fouls fuel quantity probes, sticks flow dividers, makes fuel controls sluggish.	Zero.
D. EMULSIONS				
(1) Water-in-fuel Emulsions	Light cloud. Heavy cloud.	Finely divided drops of water in fuel. Same as free water cloud. Will settle to bottom in minutes, hours, or weeks depending upon nature of emulsion.	Same as free water.	Zero–Fuel must contain no visually detectable free water.

Table 8-3.—Visual Contamination Table (Cont'd)

TYPE CONTAMINANTS	APPEARANCE	CHARACTERISTICS	EFFECTS ON AIRCRAFT	ACCEPTABILITY LIMITS
(2) Fuel and water or "stabilized" Emulsions	Reddish, brownish, grayish or blackish. Sticky material variously described as gelatinous, gummy, like catsup, or like mayonnaise.	Finely divided drops of fuel in water. Contains rust or microbiological growth which stabilizes or "firms" the emulsion. Will adhere to many materials normally in contact with fuels. Usually present as "globules" or stringy, fibrous-like material in clear or cloudy fuel. Will stand from days to months without separating. This material contains half to three-fourths water, a small amount of fine rust or microbiological growth and is one third to one half fuel.	Same as free water and sediment, only more drastic. Will quickly cause filter plugging and erratic readings in fuel quantity probes.	Zero.
E. MISCELLANEOUS				
(1) Interface Material	Lacy bubbles or scum at interface between fuel and water. Sometimes resembles jellyfish.	Extremely complicated chemcially. Occurs only when emulsion and free water is present.	Same as microbiological growth.	Zero—There should be no free water.
(2) Air Bubbles	Cloud in fuel.	Disperses upward within a few seconds.		Any amount.

sampling, the clean container should be rinsed and flushed several times with the fuel being sampled.

3. Samples should be as representative of the product being sampled as possible. Detailed instructions for bulk products are contained in the ASTM Manual on Measurement and Sampling of Petroleum Products. Samples of fuel being delivered to aircraft should be taken from the fueling nozzle during actual fueling operations. Samples taken to test fixed filter/separators should be taken at the sampling outlet nearest the filter/separator discharge.

4. Samples should be capped promptly, protected from sunlight, and handled expeditiously.

5. Sampling connections should be installed in vertical pipe runs where practicable. If they are installed in horizontal runs they should be placed in the side halfway between the top and the bottom of the pipe. Sampling connections should be flushed before taking each sample.

6. Samples should be taken with the system operating at normal flow rates and steady state if possible.

7. The bottle should be filled only to the bottom level of the shoulder, and the screw cap must be tightened securely.

SAMPLE CONTAINERS.–Aviation fuel sampling containers and shipping containers are available in the supply system.

These containers meet all requirements for shipment of aviation fuels by military and commerical transportation media.

Glass sample containers with a suitable cap having an aluminum foil seal should be used.

IDENTIFICATION OF SAMPLE.–Proper identification and accurate records of samples are absolutely necessary so that the test results may be correlated with the samples submitted.

Each sample should be assigned a serial number which can be formed by using the calendar year as the prefix number and assigning consecutive numbers as the samples are submitted. For example: the first sample submitted in 1973 would be 73-1; the second, 73-2; etc. Such sample numbers should be shown on the sample identification tag, all shipping documents, and correspondence pertaining to the sample.

The following should be used as a guide for sample identification:

1. Sample serial number (activity number).
2. Type fuel (JP-5, 115/145, etc.).
3. Name and location of activity.
4. Date sample taken.
5. Location of sample point (nozzle sample, refueler no., tank no., etc.).
6. Quantity of material represented, if applicable.
7. Classification of sample (routine or special). (See below.)
8. Name of person taking sample.
9. Tests required.
10. Remarks.

SAMPLE CLASSIFICATION.–Samples are classified either ROUTINE or SPECIAL. ROUTINE samples are taken when on fuel problems or aircraft problems attributable to fuel are known or suspected. An example would be the periodic samples taken as a part of a quality surveillance program. These should be tested for sediment and water, and, for JP-5, flashpoint. SPECIAL samples are submitted for test because the quality of the fuel is suspected, either as the result of aircraft malfunctions or other information. SPECIAL samples should have the highest priority in handling, testing, and reporting.

SHIPPING INSTRUCTIONS.–Samples are to be forwarded to appropriate testing laboratories by the most expeditious means. Wherever feasible, samples should be delivered directly to the laboratory by hand. Samples in amounts up to 10 gallons may be shipped via railway express.

Four 1-quart samples or a 1-gallon sample (i.e., 1-gallon maximum) of aviation fuel may be air shipped via military aircraft when packed in accordance with NavAir 15-03-500 (USAF AMF 71-4), which further indicates that fuel samples may be transported on passenger carrying aircraft.

CONTAMINATED FUEL DETECTOR (AEL MK III)

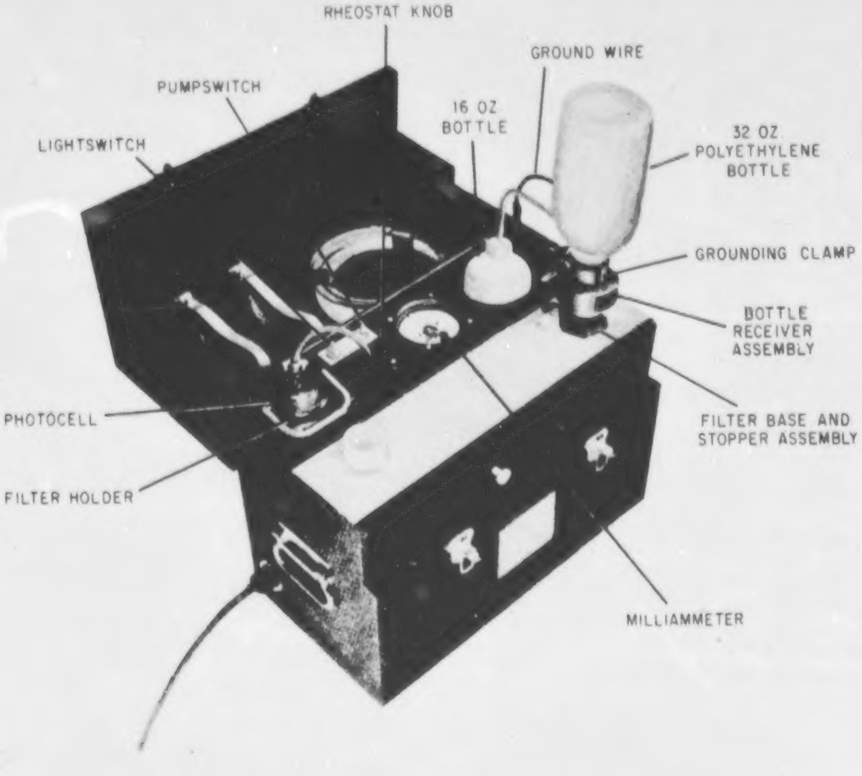
The contaminated fuel detector is a portable self-contained unit. (See fig. 8-1.) This instrument is used to determine the quantity of solid contamination present in aircraft fuels.

The detector consists of a fuel sample container, a fuel filtration system employing Millipore filters, and a light transmission system for determining the quantity of solid contaminants on the Millipore filters. All components necessary for filteration and measuring of transmitted light are incorporated into one serviceable package.

The level of fuel contamination is measured by using the principle of light transmission through a Millipore filter. A sample of fuel is filtered through the Millipore membrane.

NOTE: The Millipore filters have 0.65 micron pores. (A micron is 1/1,000,000th of a meter, or approximately 1/25,000th of an inch). Contaminating particles are retained on the surface of the membrane. If a beam of light is directed through the membrane, part of the light will be absorbed by particles of solid contaminants. In order to increase accuracy, and to eliminate any fuel color effect, two Millipore filters are used in series. The first filter traps the solid contaminants, plus fuel color effect, whereas the second filter is subjected to clean fuel and retains only the fuel color effect. Thus, the difference between light transmission through the two filters depends only on the amount of solid contamination. By measuring the difference between the amount of light transmitted through the contaminated membrane and the clear membrane, it is possible to establish the level of contamination in fuel.

The steps for preparation and use of the AEL MK III are as follows:


RHEOSTAT KNOB
GROUND WIRE
PUMPSWITCH
16 OZ BOTTLE
LIGHTSWITCH
32 OZ POLYETHYLENE BOTTLE
GROUNDING CLAMP
BOTTLE RECEIVER ASSEMBLY
PHOTOCELL
FILTER BASE AND STOPPER ASSEMBLY
FILTER HOLDER
MILLIAMMETER

198.117

Figure 8-1.—AEL MK III front view.

1. Remove the power cable from inside the instrument cover and connect it to a suitable source of 110-volt, 60-hertz power. The power cable contains a ground wire to ground the instrument.
2. Turn the light switch. The light system should be allowed to warm up for two to three minutes prior to use.
3. Make sure the fuel flask is empty and the drain cock is closed.
4. The filter base and bottle receiver assembly located in the lid should be disassembled into its two components. The section with the rubber stopper is the filter base and should be inserted into the opening in the fuel flask.
5. Place two Millipore filters right side up on the filter base. The Millipore filter is a paper-thin white membrane. These filters should be handled only with forceps, and only by their edges. Reassemble the filter base and bottle receiver assembly. Rotate the locking ring carefully to prevent damage to the filters.
6. Place the filter base and bottle receiver over the top of the 32 oz polyethylene bottle and fill to the 800 milliliter (ML) mark with fuel. All the threaded portion of the bottle top should be inserted into the bottle receiver.
7. Insert the ground wire attached to the filter base and bottle receiver assembly into the opening provided. Turn on the pump switch; a vacuum pump is connected to the fuel flask to speed up filtration. (See fig. 8-2.)
8. Insert the entire assembly (filter base, bottle receiver, and fuel sample bottle) into the fuel flask. After all the fuel has passed through the filters, and the bottle receiver has been removed exposing the filters, stop the pump. During the filtration cycle, the fuel in the sample bottle should be agitated occasionally by gently shaking the bottle to insure that any contaminants are washed down and not lodged on the inside surface of the bottle. If the sample bottle tends to collapse, gently loosen the bottle

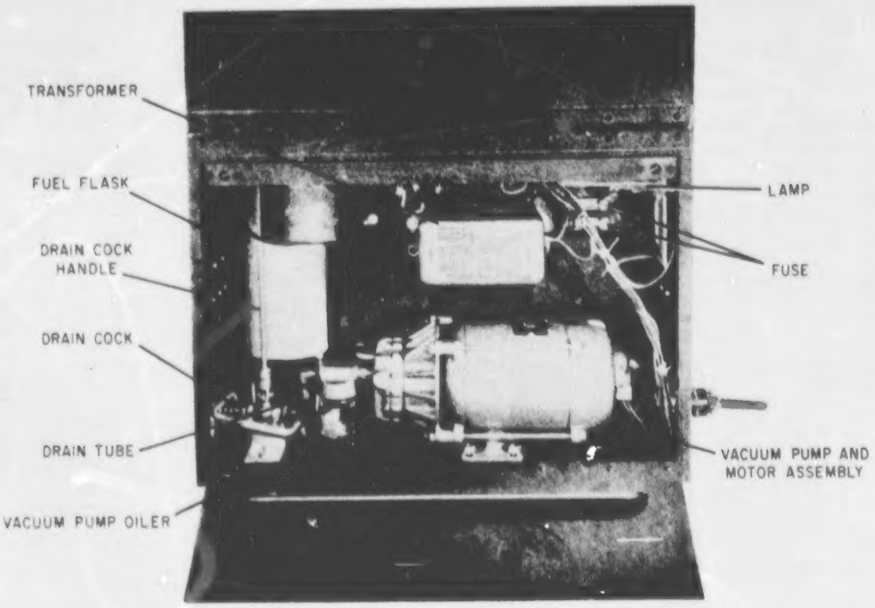


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Figure 8-2.—AEL MK III rear view.

in the bottle holder by tilting it slightly during the filtration cycle.

NOTE: Prior to measuring the contamination on the filters, the photocell and light window should be cleaned.

9. Drain the fuel from the flask through the tygon tubing into a suitable container.

10. With the filter out of the receptacle, swing the photocell into measuring position. Insure it is fully seated.

11. Adjust the rheostat knob for a light intensity reading of 0.6 on the milliammeter.

NOTE: If sufficient control is not available with the rheostat knob to obtain a reading of 0.6 milliamps, set the rheostat at midscale. Observe the meter reading with the light on the photocell in the measuring position without a filter in the receptacle. Disconnect the power cable of the instrument and open the back. Loosen the lightbulb holder slightly. If the meter reads below 0.6 milliamps, slide the bulb holder up. If the meter reads over 0.6 milliamps, slide the bulb holder down. The filament of the lightbulb should be horizontal after the change is made. Temporarily close the case, connect the power cable of the instrument, turn on the light, and check the meter reading. It is not necessary to obtain an exact reading of 0.6 milliamps by adjustment of the light bulb, as final fine adjustments will be made by use of the rheostat. When a suitable position for the light bulb has been found that will permit adequate adjustment by the rheostat, retighten the nuts on the bulb holder. Refasten the back of the instrument.

12. Using forceps, pick up the contaminated filter top and wet it with clean (prefiltered) JP-5. Insure the entire filter becomes wet with fuel.

13. Lift the photocell and, using forceps, place the contaminated filter in the receptacle.

14. Swing the photocell back into measuring position and insure it is fully seated.

15. Record the reading on the milliammeter; this reading is in thousandths of a milliamp.

16. Remove the filter. Check to see that the meter still reads 0.6 milliamps; if not, adjust to 0.6.

17. Repeat steps 12 through 16 using the clean (bottom) filter.

18. Subtract the meter reading obtained from the contaminated filter from the meter reading obtained from the clean filter. This change in reading value is used in conjunction with the calibration chart in figure 8-3.

19. Find this value on the left of the chart, then move horizontally until the reference line is intersected. Read vertically at either the top or bottom of the chart to determine the amount of contamination in either milligrams per gallon, or millgrams per liter.

NOTE: Each contaminated fuel detector has its own calibration curve, which will be marked with the same serial number as the unit.

It should be recognized that this instrument is only a secondary standard and does not replace the requirements for periodic laboratory analysis, but supplements the laboratory analysis. Extensive field tests have demonstrated that the calibration curve furnished with this unit is valid for the majority of fuel samples, but there are occasional samples which do not fit the normal pattern. It may become necessary to establish a new or modified calibration curve in a few unusual cases where the contaminants in a particular system do not follow normal patterns. Duplicate samples sent to the laboratory for gravimetric analysis will give a cross-check on the instrument and quickly pinpoint these unusual systems.

To obtain an original curve or check an old curve, the Aeronautical Engine Laboratory in Philadelphia will furnish a set of Wratten calibration filters. These filters are marked with a preset contamination value. The AEL MK III must be calibrated quarterly, or whenever a part is replaced. The accuracy and value of this unit will depend upon the personnel operating it. If the results are to be valid, the fuel samples must

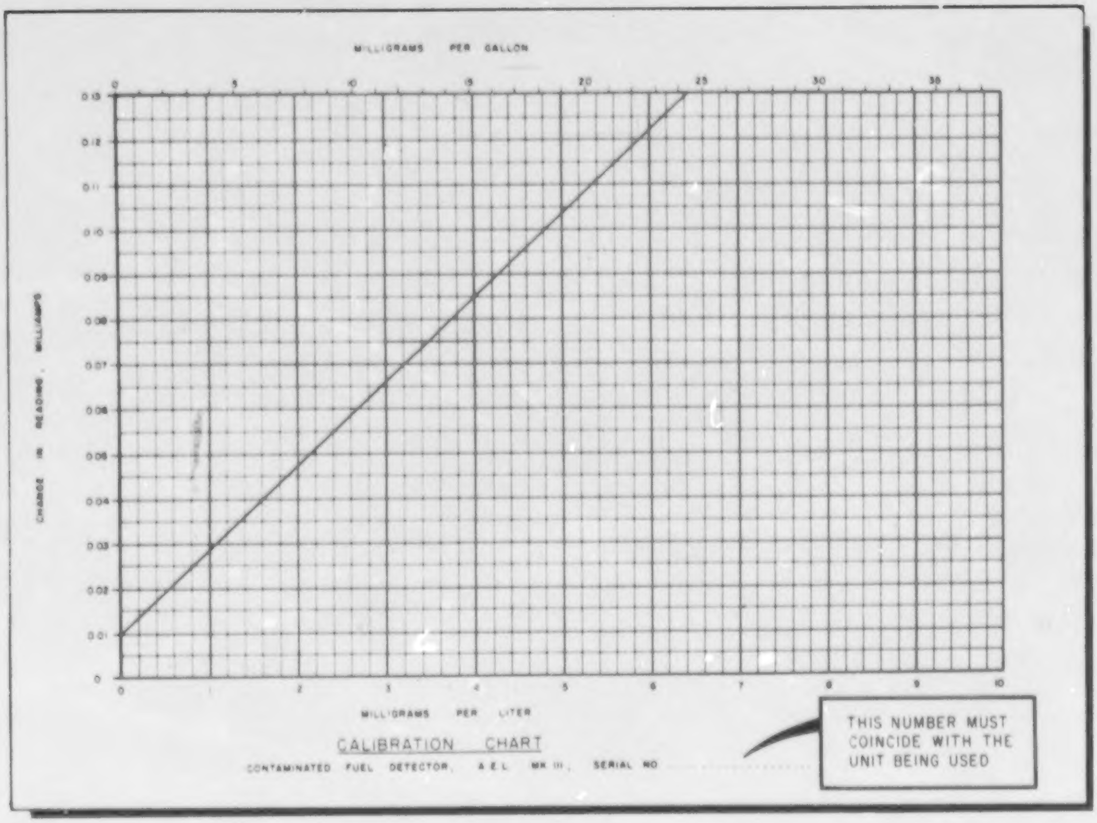

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Figure 8-3.—Calibration chart.

be truly representative and the whole operation conducted so that nothing extraneous is introduced.

For detailed information on maintenance and calibration procedures refer to NavShips Technical Manual 315-0145.

FREE WATER DETECTOR (AEL MK I)

The aeronautical Engine Laboratory (AEL), of the Naval Air Engineering Center has developed a simple, low-cost detector that can be used on all aviation ships and air stations for accurately measuring trace quantities of undissolved water in aviation fuels. The device, called a Free Water in Fuel Detector, has been field tested and found to be very accurate. It is designed for use in conjunction with the AEL Mk III discussed earlier.

The free water detector consists of an ultraviolet light source; a set of standards indicating 0, 5, 10, and 20 parts per million, as shown in figure 8-4, and water detector test pads through which the fuel sample is passed. The detector test pad and standards are shown in figure 8-5. The three basic components, which include the viewer, two spare sets of standards, and one box of 50 test pads, are shown in figure 8-6.

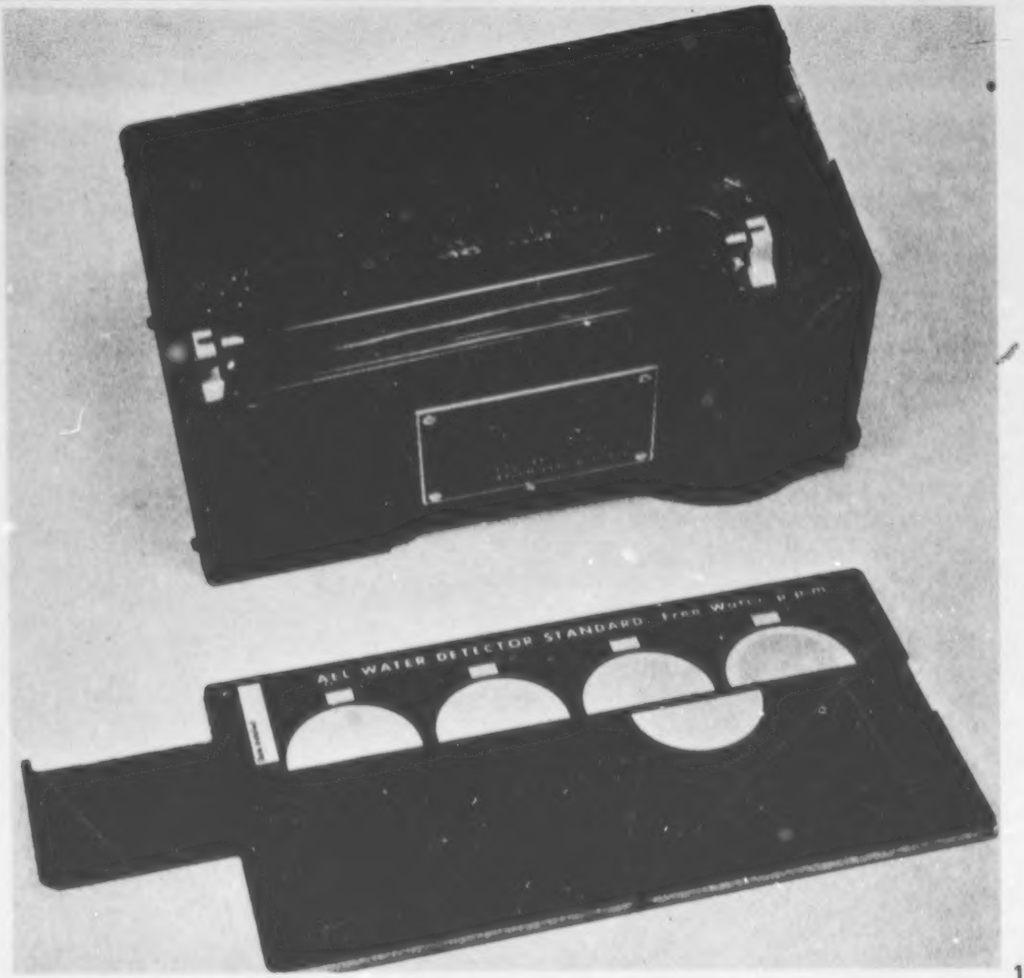

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Figure 8-4.—Light source and standards—free water detector.

Instructions for Using the AEL Free Water Detector

1. Mark the polyethylene bottle 3¼ inches from the bottom. When the bottle is filled to this mark, a 500-cc sample will be obtained.
2. Fill the polyethylene sample bottle to the 500-cc mark with fuel to be tested.
3. Open a free water detector envelope and place the detector pad, orange side up, on the Contaminated Fuel Detector base. Attach the bottle receiver to the filter base and plug in the ground wire jack.

   CAUTION: Handle the detector pad with forceps only.
4. Check to see that the Contaminated Fuel Detector fuel flask is empty and the drain cock closed.
5. Shake the bottle containing the 500-cc fuel sample vigorously for approximately 30 seconds.
6. Immediately after shaking, turn the vacuum pump on, unscrew the bottle cap, place the bottle receiver firmly over the end of the bottle and insert the filter base into the Contaminated Fuel Detector. (This step should be accomplished in as short a time as possible in order to keep any free water in suspension.)
7. After the 500-cc sample has passed through the detector pad, turn off the vacuum

pump IMMEDIATELY, and remove the bottle and bottle receiver. NOTE: Under no circumstances continue to draw air through the detector pad. Remove the pad from the filter base with forceps and place it (orange side up) in the free water detector slide depression.

8. Light the ultraviolet bulb in the free water detector by holding the light switch in the ON position, and insert the slide containing the test pad.

9. Look through the view port of the box and compare the brightness of the test pad with that of the set of standards to determine the amount of free water. Free water content is indicated in parts per million (ppm) by the numbers located directly above the standards. Results should be reported as "No Free Water" or as actual free water content (estimated to the nearest part per million).

10. If the result is over 20 ppm take a new sample of one-half the standard sample and double the answer.

NOTE: The "standards" card in the free water detector must be replaced after 6 months of use. Two spare sets have been included with the kit for this purpose.

The standards in the box when received should be marked with the date on which the detector is first put into use.

Spare Parts: Free water detector kits, spare parts, and necessary material are available from the Navy Supply System. The ordering information is as follows:

	FED. STOCK NO.
Viewer Kit, Free Water Detector (1 viewer 500 pads, 3 stds.)	6850-999-2786
Printed Standard (1 each)	6850-999-2784
Detector Pads (pkg. of 500)	6850-999-2785
Ultraviolet lamp (1 each)	6240-683-0723

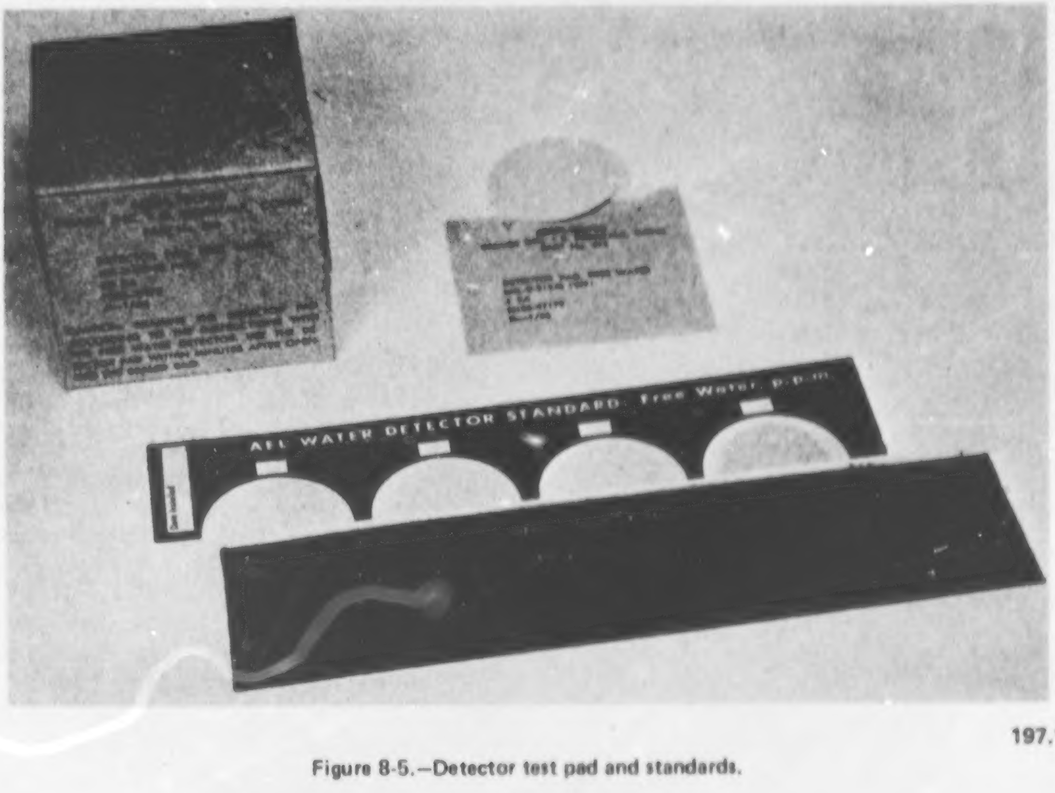

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Figure 8-5.—Detector test pad and standards.

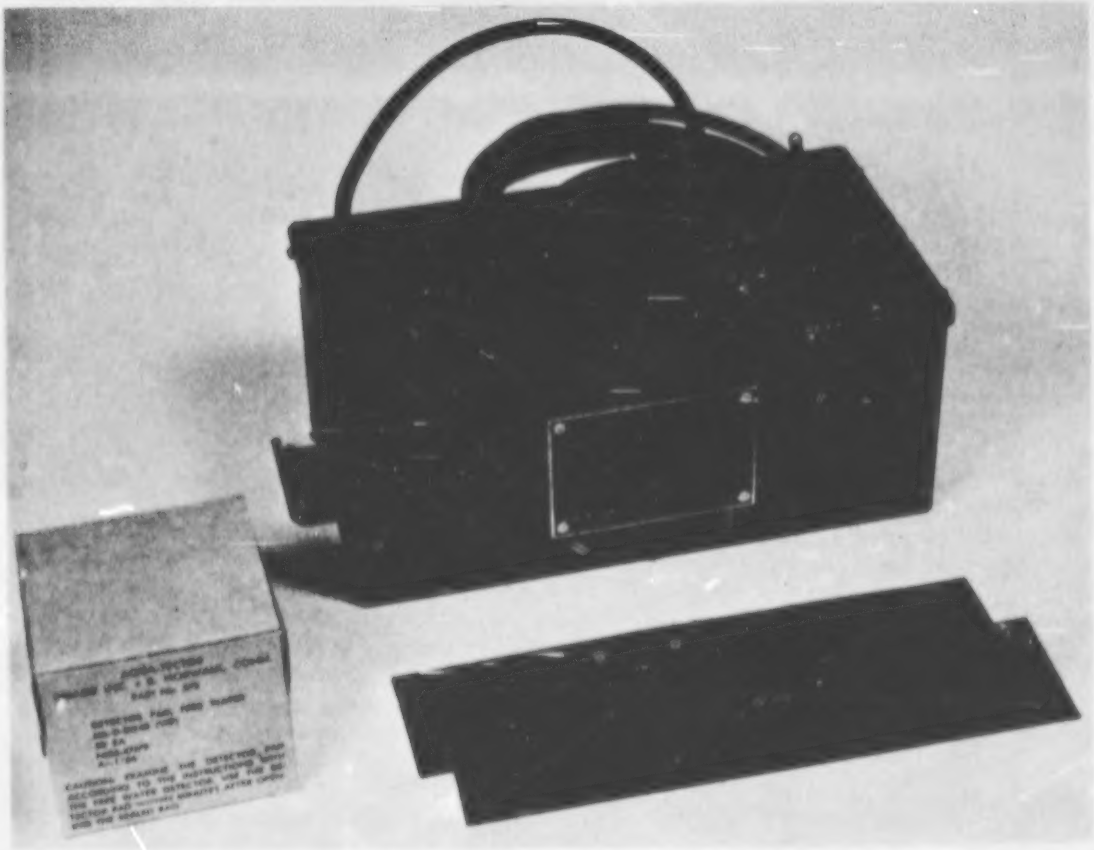

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Figure 8-6.—Viewer, standards, and test pads.

Ultraviolet lamp starter
(1 each) 6250-299-2884

Use each detector pad only once.

Momentary light switch is used to prevent undue ultraviolet radiation of standards. DO NOT CHANGE.

When testing JP-5 with the AEL MK I, if the filter separators are not removing water down to the specified limits, it may be due to contamination with Navy distillate or diesel fuel.

Laboratory tests at the Naval Air Propulsion Test Center show that the one property of JP-5 fuel which is most affected by contamination with small amounts of Navy distillate fuel is the WSIM (Water Separometer Index, Modified). Navy distillate at a concentration of less than 0.5% reduces the WSIM value below 70. WSIM is related to filter/separator performance, and a value lower than 70 could result in a loss of water-removing ability by the filter/separators. WSIM cannot be determined on board ship and it is necessary to send a sample to a laboratory having the apparatus to perform the test. There are only four Navy laboratories equipped to perform the WSIM test: C.O., U.S. Naval supply Center, Norfolk, Va. 23511 Attn: Petroleum Testing Lab; C.O., U.S. Naval Supply Center Code 704, Pearl Harbor, Hawaii 96610; C.O., U.S. Naval Supply Center Code 956, 937 N. Harbor Dr., San Diego, Calif. 92131, Attn: Petroleum Testing Lab, Pt. Loma; C.O., U.S. Naval Supply Depot, Subic Bay, Republic of the Phillipines, Attn: Petroleum Testing Lab.

FILTER ELEMENT TEST STAND

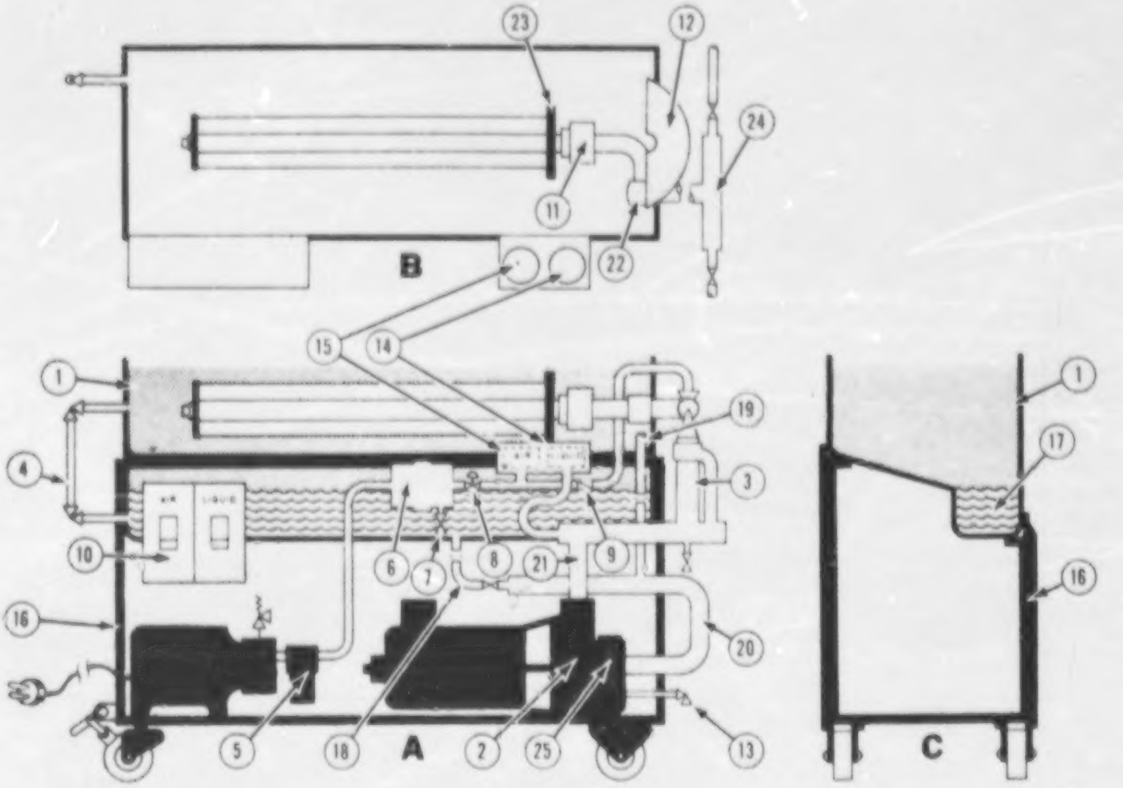
The purpose of the filter element test stand is to test the integrity of coalescer elements under actual flow conditions with a fuel/water mixture.

The filter element test stand (fig. 8-7) is a compact, lightweight unit, mounted on rubber swivel type rollers. An individual brake is provided for each roller to secure the unit in the desired location.

DETAILED DESCRIPTION

Test Tank

The test tank (1, fig. 8-7) consists of a 17-gallon open top tank, mounted horizontally



1. Tank.
2. Centrifugal pump.
3. Flow indicator.
4. Liquid level gage.
5. Air pump.
6. Air receiving tank.
7. Drain line for air tank.
8. Pressure reducing valve.
9. Check valve.
10. Motor switches.
11. Holding assembly.
12. Splash pan.
13. Drain valve.
14. Liquid pressure gage.
15. Air pressure gage.
16. Aluminum frame.
17. Sump tank.
18. Water suction line.
19. Fuel suction line.
20. Common suction header.
21. Pump discharge.
22. Swing joint.
23. Circular handle.
24. Holding element feed line.
25. Strainer.

198.55

Figure 8-7.—Filter element test stand.

on top of the frame. The tank is constructed of copper and provides a suitable rust-free container for the fuel/water mixture required for testing coalescer elements. One side of the tank bottom is recessed the entire length of the tank. This recessed portion of the tank bottom provides for a water receiving sump (17). The remainder of the tank bottom is slanted to insure that water separated from the fuel returns to the sump.

The test tank contains an element holding assembly, sight glass gage, water suction line, fuel suction line, and holding element liquid/air feed line.

The holding assembly (11) provides a fast, easy, and efficient method of installing, testing, and removing filter elements, and consists of a 17½-inch nonremovable standard element mounting assembly.

Two screw adapters are provided for screwing into the end of the fixed portion of the mount to accommodate both 20- and 24-inch elements. The swing joint (22) allows for raising the holding assembly vertically out of the tank for installation and removal of the elements, and for lowering the holding assembly horizontally into the tank for testing. The swivel provides a means of rotating the elements in the test fluid during the testing period. An enlarged circular handle (23) is mounted on the base cap for this purpose.

The sight glass gage (4) for visually observing the fuel and water level is installed on the end of the test tank. The lower end of the gage is attached to the sump, and the upper end is attached to the main body of the tank. Shutoff valves are provided at the top and bottom of the gage to enable the glass to be removed for cleaning, maintenance, and so forth. Two red indicating lines are painted on the lower section of the gage glass. These lines are used to indicate the proper water level within the sump.

CAUTION: The proper water level in the sump must be maintained between the two red lines.

The water suction line (18) extends from the bottom of the sump to the common suction header of the liquid pump. This line is fitted with an orifice and globe-type shutoff valve for controlling the flow of water to the pump.

The fuel suction line (19) extends from mid-point in the main body of the test tank to the common suction header of the liquid pump. An orifice is installed in this line to regulate the flow of fuel to the pump.

The holding element liquid air feed line (24) extends from the swivel joint out through the end of the test tank and terminates in a tee. The centrifugal pump discharge line is connected to one side of the tee, and the air pump discharge line is attached to the opposite end of the tee.

The liquid pump (2), used for testing coalescer elements, is a single-suction centrifugal type pump, driven by an explosion-proof electric motor. The pump casing contains a strainer, drain line, inlet suction line, and discharge line.

The bucket type strainer (25) is located and built integrally with the inlet section of the pump casing. A removable cover plate is installed on top of the casing for gaining access to the strainer for cleaning.

A drain line (13), fitted with a petcock, is installed in the extreme bottom of the pump casing. This line is used to drain both the pump casing and the test tank.

The pump inlet port is connected to the common suction header (20). The water suction line (18) and fuel suction line (19) from the test tanks are connected to the common suction header.

The pump discharge pipe (21) extends from the discharge compartment to one side of the tee of the holding element feed line. This line is fitted with a flow indicator, flow control valve, and pressure gage line.

The flow indicator gage (3) is provided to visually observe the rate of liquid flow being discharged into the coalescer element during test. This flow should not exceed 10 gpm. The gage is graduated to read the scale at a point opposite the grooved horizontal line on the float. A drain line is installed in the bottom of the gage.

The flow control valve is an angle type globe needle valve. It is located between the flow indicator and test tank. This valve is manually operated to regulate the desired rate of flow through the element.

The pressure gage is provided to determine the pressure of the liquid being discharged through the element. The pressure should be maintained between 10 and 12 psi when testing.

PREPARATION FOR TESTING ELEMENTS

To prepare the unit for testing elements, proceed as follows:

1. Position the unit to insure it is level, and then lock the wheels.
2. Visually inspect for distorted copper tubing, loose fittings, and any debris inside the tank.
3. Fill the test tank with 15 gallons of fuel.
4. To insure that the fuel is clean, install a coalescer element on the holding assembly and flush the system by recirculating the fuel for 10 minutes.
5. Remove 2½ gallons of fuel from the test tank.

NOTE: Fuel is removed through the drain line at the bottom of the centrifugal pump casing.

6. Add 2½ gallons of clean water to the test tank.

NOTE: To insure proper water level, observe the sight glass gage on the test tank. Water level should be between the two red indicating marks.

The unit is now ready for testing elements.

OPERATION

In describing the piping and valve alinement for each of the testing operations, only the valve numbers will be referred to. Each valve on the test unit has numbers corresponding to those indicated in figure 8-8. Refer to this figure while reading the following test procedure.

1. Raise the holding element mounting assembly vertically and install a coalescer element.

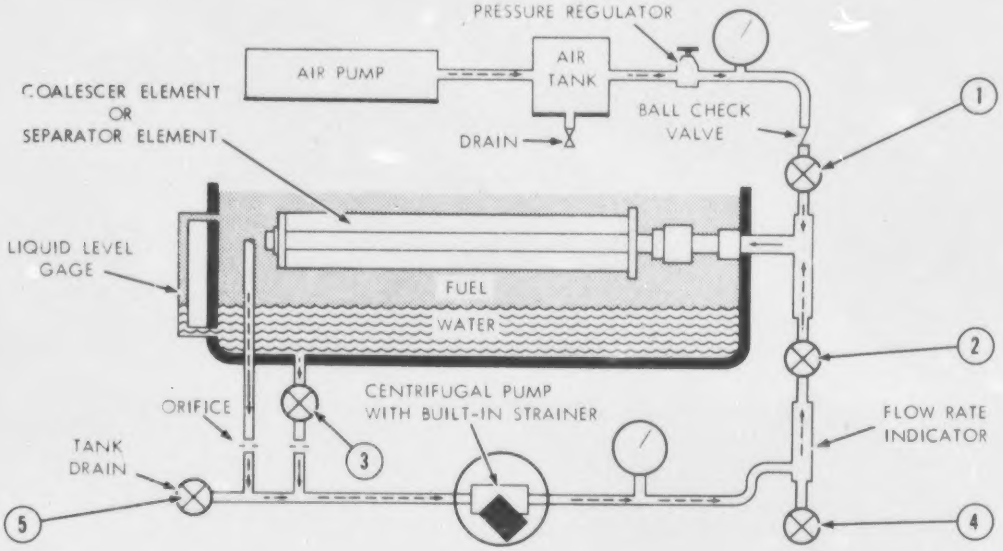
CAUTION: Insure that the element is properly sealed at each end. Test for correct tightness by attempting to rotate the element on the mounting stand. If the element can be easily rotated, further tightening of the end cap wingnut will be necessary.

NOTE: It may be necessary to add an additional end gasket to obtain the proper seal.

2. Lower the element into the fuel. Fuel level should be approximately 1 inch above the element.
3. Insure that Valve No. 1 is closed.
4. Open Valve No. 2, one-half turn; this will allow approximately 10 gpm to flow through the element.
5. Start the centrifugal pump and adjust the flow to exactly 10 gpm as indicated on the flow control valve. This is accomplished by adjusting Valve No. 2.
6. Open Valve No. 3. The orifice in this line regulates the flow of water into the fuel stream at ¾ gpm.
7. Obtain a 1-liter sample at Valve No. 4, and determine the total water content. The sample container must be graduated in 100 units. A proper mixture should be nine parts fuel and one part water. Adjust the glove valve in the water suction line as necessary to obtain the proper ratio of fuel/water mixture.
8. Rotate the coalescer element and observe the integrity of the element for 2 minutes. A defective element will produce a haze similar to smoke coming through the element at the point of leakage. A satisfactory element will produce clear fuel with clear coalesced water droplets at the outer surface of the element.
9. Stop the liquid pump. Replace the coalescing element and continue testing.
10. When the last coalescer element has been tested, close Valve No. 3 (stopping the waterflow) and let the system operate at least 1 minute, or until the system is clear of water.
11. Stop the centrifugal pump.
12. Raise the holding assembly vertically and remove the last element. Leave the assembly in this position to allow the fuel to drain out of the stand pipe.
13. After the fuel has drained back, close Valve No. 2.

Permanent Type Filter/Separator Elements

Prior to installation, all Teflon coated permanent type filter/separator elements are to be checked:


PRESSURE REGULATOR
AIR PUMP
AIR TANK
COALESCER ELEMENT OR SEPARATOR ELEMENT
BALL CHECK VALVE
DRAIN
1
LIQUID LEVEL GAGE
FUEL
WATER
2
CENTRIFUGAL PUMP WITH BUILT-IN STRAINER
ORIFICE
FLOW RATE INDICATOR
TANK DRAIN
3
5
4

1. Valve No. 1 – Needle valve in air line.
2. Valve No. 2 – Angle-type needle valve in liquid.
3. Valve No. 3 – Globe valve in water suction line.
4. Valve No. 4 – Flow indicator drain valve.
5. Valve No. 5 – Pump drain line.

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Figure 8-8.—Flow diagram—coalescer element test/air bubble test.

1. Make a careful visual inspection to check for flaws in the element.

2. Fill the interior of the element (held in the horizontal position) with enough water (approximately ¼-inch in depth) to cover the entire lower section along the longitudinal axis. Slowly rotate the element and look for leakage. Take special note of the seam. There should be no leakage.

Acceptance is based on not one but both of the above tests.

Lubrication

The oil filter passes all incoming air. Fill the jar to the line indicated on the oil level decal. One filling should last 20 to 50 hours of operation. The motor bearings are oiled annually. Refer to the MRC for the proper type of oil.

Centrifugal Pump

Never operate the pump dry. Operate the pump at least once a week for a minimum of 2 minutes. Be sure the pump primes and pumps a full stream before shutting down. This will prevent a buildup of rust on the impeller and pump seal. It will also lubricate the bearings. In performing this minimum maintenance, you can be sure the pump will always be ready for operation.

Flow Rate Indicator

Normal maintenance consists of cleaning the float and tube to maintain good visibility. Care should be taken in removing the fittings to prevent dropping the gage. Clean with a suitable solvent, then replace the parts. During reassembly, it is preferable to use new O-rings.

NOTE: A complete parts list will be found in the technical manual, NavShips 345-0474.

HORIZONTAL FUEL FILTERS

A basic description of filters and their piping and valve arrangement was covered in chapter 3 of this training manual. This section gives a more detailed description, and covers the operation and maintenance of the filters and their automatic control devices.

DETAILED DESCRIPTION

The main body of the filter consists of a cylindrically shaped shell (tank) with a dome-shaped head welded on each end. (See fig. 8-9.) The dome-shaped heads provide a uniform flow into and out of the filter. The interior of the filter is divided into three separate chambers, inlet, fallout, and outlet, by tube sheets.

Tube Sheet

The tube sheets are circular metal bulkheads installed within the filter shell, where the dome-shaped heads are attached to the cylindrical-shaped shell. They are welded throughout their circumference to form a leakproof partition between inlet, fallout, and outlet compartments of the filter. The tube sheets also provide the means of installing the filter element mounting assemblies (both coalescer and separator). Threaded holes (one for each assembly) are symmetrically arranged over their surface.

Element Mounting Assembly

The element mounting assembly (fig. 8-10) consists of a perforated metal standpipe (1) approximately 1 inch in diameter and 26 inches in length, and an end cap (2). One end of the standpipe is fitted with a threaded base cap (3) to facilitate screwing it into the tube sheets. The opposite end is fitted with a threaded plug (4) for attaching the end cap. The end cap is a metal

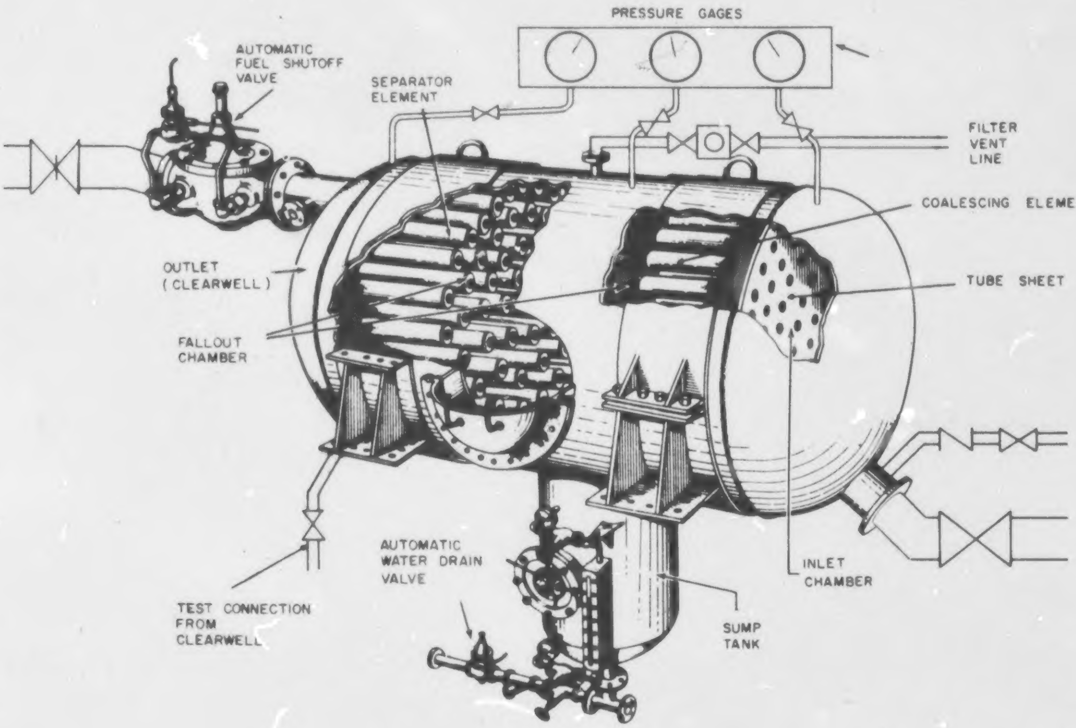
PRESSURE GAGES
AUTOMATIC FUEL SHUTOFF VALVE
SEPARATOR ELEMENT
FILTER VENT LINE
COALESCING ELEMENT
TUBE SHEET
OUTLET (CLEARWELL)
FALLOUT CHAMBER
AUTOMATIC WATER DRAIN VALVE
INLET CHAMBER
TEST CONNECTION FROM CLEARWELL
SUMP TANK

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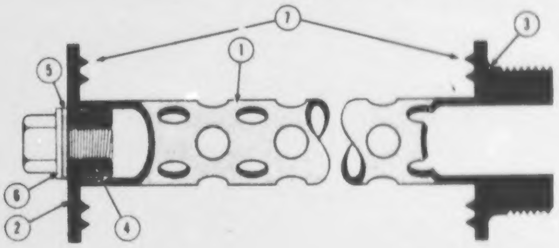
Figure 8-9.—Horizontal fuel filter (cutaway).



1. Standpipe.
2. End cap
3. Base cap.
4. Threaded plug.
5. Fiber washer.
6. Metal washer.
7. Knife edges.

198.58

Figure 8-10.—Element mounting assembly.

disc approximately the same diameter as the elements.

After the filter element has been placed over the standpipe, the end cap is secured in place by a threaded bolt. A metal washer (6) and fiber washer (5) are provided between the threaded bolt and end cap to prevent leakage at this point.

Both the base cap (the inboard end of the standpipe) and the end cap have projecting knife edges (7). When the elements are mounted on the standpipes, the projecting knife edges are forced into the synthetic rubber gaskets on each end of the elements, forming a tight seal.

Coalescing Element

The coalescing element is a cylindrical unit approximately 24 inches long and 3 5/8 inches in diameter. It consists basically of a layer of fiber glass approximately 2 inches thick installed around a perforated metal center tube. The fiber glass is held in place by a cloth sleeve and protected by a perforated metal outer tube. The ends (between the two metal tubes) are sealed by metal plates (washers). A synthetic rubber gasket is attached to each end of the element. These gaskets form a tight seal and insure flow through the element when mounted.

Separator Element

The separator element has practically the same dimensions as the coalescer; however, it is constructed of different material. A specially designed permanent type separator element has been introduced into fleet use, replacing the old paper filter. It consists basically of a perforated inner aluminum core cover with a 200-mesh monel Teflon coated screen. This screen is enclosed by an additional aluminum screen.

Installing Elements

To install an element on the standard element mounting stand, proceed as follows:

1. Insure that the gaskets are in place, then slide the element over the perforated standpipe.
2. Attach the end cap, with metal and fiber gasket in place, and install the threaded bolt fingertight.
3. Center the element on the mounting stand with one hand, and by use of the proper size wrench, tighten the end capnut snugly.
4. Check the element for tightness; if the element can be easily rotated on the standpipe, further tightening is required. This is accomplished in a two-stage operation, by the two separate filtering media.

Filter Inlet Chamber

Fuel enters the filter initially at the bottom of the inlet chamber. This chamber of the filter is dome-shaped to provide a uniform flow of fuel to all coalescing elements simultaneously. From the inlet chamber the fuel passes through coalescing elements to the fallout chamber.

Fallout Chamber

The fallout chamber is the center section of the filter shell. It is the longest of the three individual sections. This area of the filter is provided to allow the coalesced water to fall out of the fuel stream by gravity as it flows from the coalescer to the separator stage. All of the filtering elements, both coalescing and separator, are installed within this section of the filter.

The fallout chamber also contains a manhole cover, filter vent line, and water receiving sump.

The coalescing stage is the first stage of filtration. It consists of a number of individual coalescer elements grouped in a symmetrical arrangement on the inlet tube sheet. The fuel leaving the inlet chamber must pass through these elements from the inside to the outside before entering the fallout chamber. As the fuel passes through the elements, they perform the dual function of removing solid contaminants from the fuel and coalescing water (bringing together entrained water in the fuel to form large droplets).

A bolted manhole cover with gasket is installed on the side of the filter shell. This opening is provided to allow personnel to gain entrance to the fallout chamber for replacing elements, maintenance, and so forth.

A filter vent line is installed at the extreme top of the fallout chamber. This line, fitted with a bull's-eye sight glass gage, two shutoff valves (one on each side of the gage), and a one-way check valve, terminates overboard. The filter shell is vented until a solid stream of JP-5 is observed at the bull's-eye sight glass gage.

The separator stage is the second stage of filtration. It consists of a number of individual separator elements grouped in a symmetrical arrangement on the outlet tube sheet.

Fuel leaving the fallout chamber must pass through separator elements from the outside to the inside before entering the outlet (or clear-well section). As the fuel passes through these elements, they perform the dual function of removing micron particles from the fuel and repelling the final traces of coalesced water that did not fall out of the fuel stream by gravity.

Water Receiving Sump

The filter sump is a cylindrical-shaped tank with a dome-shaped bottom located midpoint and directly below the filter fallout chamber. This tank receives the water that has been separated from the fuel. The capacity of the sump tank is approximately 5 percent of the rated capacity of the filter.

A reflex type sight glass gage is installed on one side of the sump tank for observing the water level within. Shutoff valves are installed in the connecting piping for isolating the gage during maintenance, cleaning, and so forth.

Centrally located on the side of the sump tank is a flanged opening to which is bolted a rotary control valve. This valve is attached to, and mechanically operated by, a ball float housed within the filter sump.

NOTE: The float-operated rotary control valve is a part of the filter automatic hydraulic device to be explained in detail later in this section.

Outlet Chamber

This section of the filter is referred to as the clearwell section. It has a dome-shaped head which provides an even, unrestricted flow of fuel from the separator stage.

A test connection for obtaining a sample of the fuel being discharged is located at the bottom of the outlet chamber. When it is necessary to drain the filter completely, the outlet chamber is drained into containers through this line.

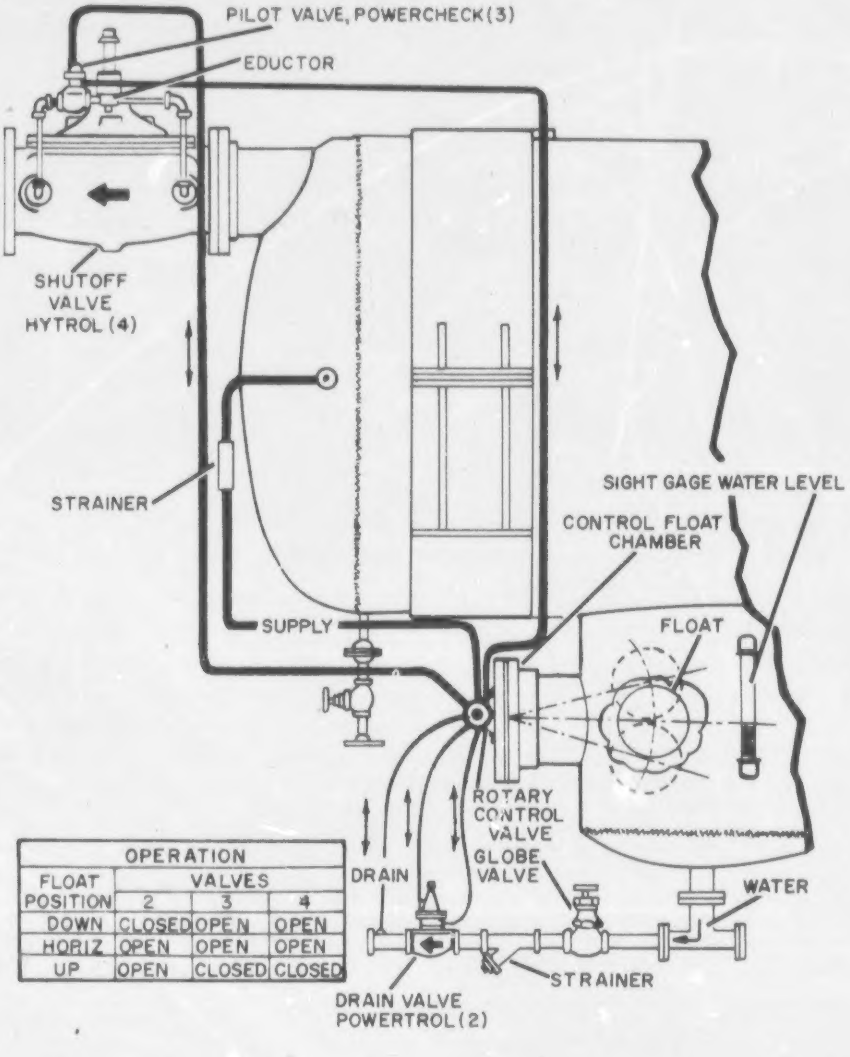
The supply line to the hydraulic control system is connected to the outlet section. This line is fitted with a wire mesh strainer at the filter end. The strainer MUST be removed and cleaned as necessary.

Three pressure gages (one for each chamber) are installed on a gage board conveniently located in the filter room. These gages are provided for determining the pressure drop across the filter elements. A shutoff valve is installed in each gage line to permit removal of the gages for test and repair.

Filter Hydraulic Control System

The filter hydraulic control system (fig. 8-11) is a safety device installed on all fuel filters. It functions to drain automatically the accumulated water from the filter sump, and to shut off the filter flow in the event more water accumulates than can be drained off automatically.

This system consists of two hydraulic control valves and a mechanically operated control valve. One control valve (the automatic shutoff valve) is located in the filter discharge line. The other control valve (the automatic water drain valve) is located in the filter sump drain line. The mechanically operated control valve (rotary valve) is located on the side of the filter sump tank.


PILOT VALVE, POWERCHECK (3)
EDUCTOR
SHUTOFF VALVE HYTROL (4)
STRAINER
SUPPLY
SIGHT GAGE WATER LEVEL
CONTROL FLOAT CHAMBER
FLOAT
ROTARY CONTROL VALVE
GLOBE VALVE
WATER
DRAIN
STRAINER
DRAIN VALVE POWERTROL (2)

OPERATION			
FLOAT POSITION	VALVES 2	3	4
DOWN	CLOSED	OPEN	OPEN
HORIZ	OPEN	OPEN	OPEN
UP	OPEN	CLOSED	CLOSED

198.59

Figure 8-11.—Filter controls.

AUTOMATIC SHUTOFF VALVE.—The automatic shutoff valve is of a modified globe valve design, using a well-supported and reinforced diaphragm as a working means. A tension spring located in the upper valve chamber (above the diaphragm) assists in seating the valve when closing, and provides a cushioning effect when opening. The valve is opened by filter discharge pressure acting under the valve disc. The valve is closed by filter discharge pressure acting on top of the diaphragm in the valve cover chamber. The pilot valve and an eductor, both located in the actuating line, control opening and closing of the automatic shutoff valve.

The actuating line runs from the inlet to the discharge side (bypassing the valve seat) of the automatic shutoff valve body.

The pilot valve is of the modified globe valve design, having a double-acting diaphragm as its working means. When fuel pressure is applied to the top of the diaphragm, the valve closes (closing off the actuating line). When fuel pressure is applied to the bottom of the diaphragm, the valve opens (allowing flow through the actuating line).

NOTE: When pressure is applied to one side of the diaphragm, the opposite side is vented to atmosphere through the drain line.

The eductor is located in the actuating line between the pilot valve and the inlet side of the shutoff valve. The eductive suction line is connected to the top of the shutoff valve cover chamber. With the pilot valve open, the eductor decreases the fuel pressure on top of the diaphragm of the shutoff valve by educting fuel from the main valve cover chamber. This decrease in fuel pressure on top of the diaphragm allows filter discharge pressure acting under the shutoff valve disk to open the valve. When the pilot valve closes, filter discharge pressure in the actuating line is directed through the eductive suction line to the top of the cover chamber of the shutoff valve. This increase in fuel pressure on top of the diaphragm cover overcomes the fuel pressure being applied on the valve disk and closes the valve. Therefore, it can be said, "When the pilot valve is open, the automatic shutoff valve is open; and when the pilot valve is closed, the automatic shutoff valve is closed."

AUTOMATIC WATER DRAIN VALVE.–This valve, located in the water drain line from the sump, is identical to the pilot valve. It also functions in the same identical manner as the pilot valve. When fuel pressure is applied to the top of the diaphragm in the water drain valve, the valve closes and stops the flow from the filter sump. When fuel pressure is applied to the bottom of the diaphragm in the water drain valve, the valve opens and allows water to be discharged from the filter sump. When fuel pressure is applied to one side of the diaphragm, the opposite side is vented to atmosphere through the drain line.

ROTARY CONTROL VALVE.–The rotary control valve, located on the side of the filter sump, is actuated by the rise and fall of a captivated ball float, housed within the filter sump tank. (See fig. 8-12.)

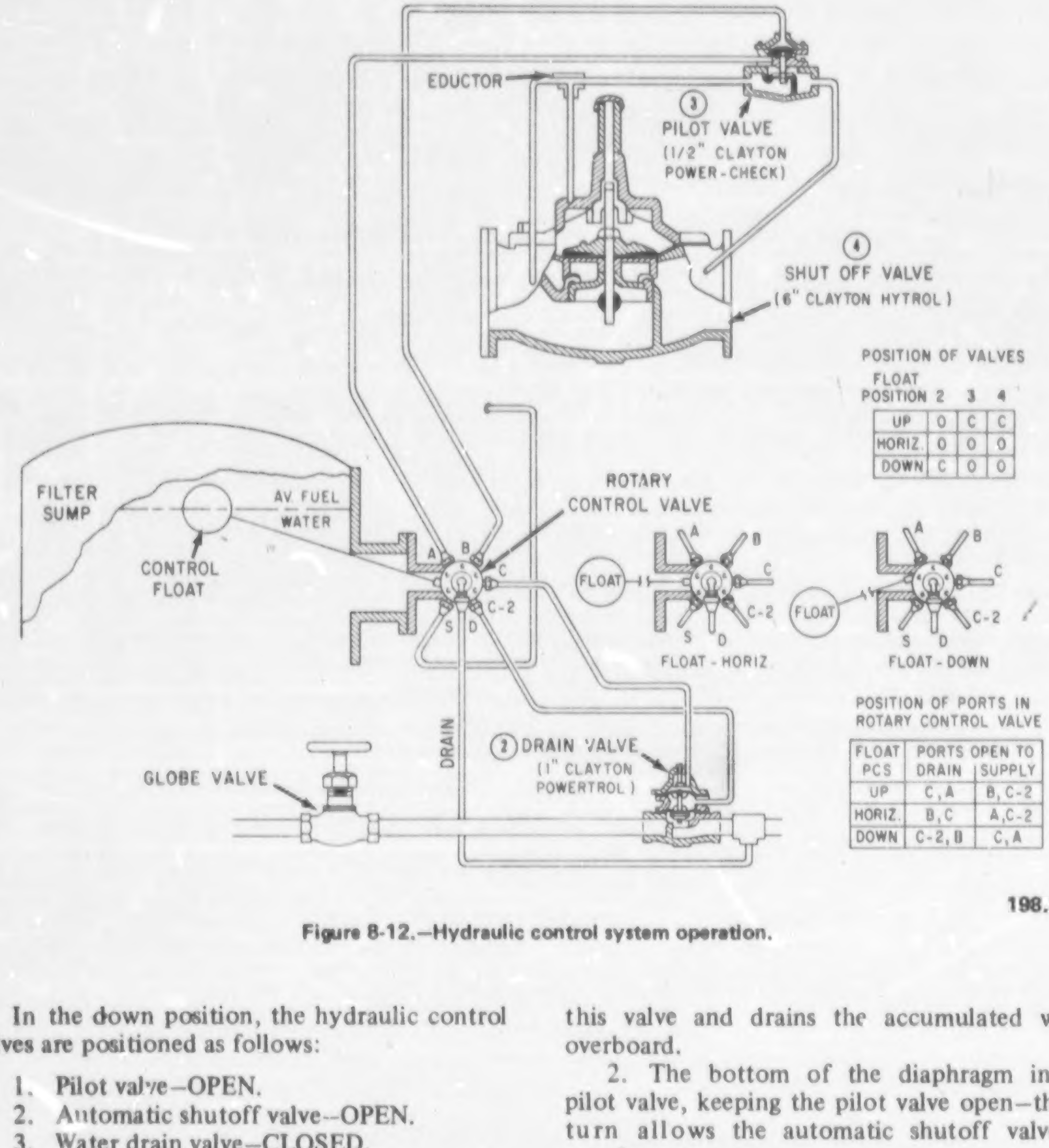
The ball float, attached to the rotary valve by a float arm and gear assembly, is designed to float on water and sink in JP-5.

The rotary control valve has three positions–DOWN, HORIZ, and UP, and six ports which are connected by copper tubing to the following:

1. A supply port (S) from the filter clearwell section.
2. A vent port (D) to atmosphere (this line is connected to the sump water drain line on the discharge side of the automatic water drain valve).
3. Port (B) to the top of the pilot valve diaphragm.
4. Port (A) to the bottom of the pilot valve diaphragm.
5. Port (C) to the top of the water drain valve diaphragm.
6. Port (C-Z) to the bottom of the water drain valve diaphragm.

The rotary control valve, through the action of the ball float, controls the opening and closing of the automatic water drain and pilot valves. This is accomplished by directing filter discharge pressure from the supply port through the rotary control valve to either the top or bottom of their diaphragms, while simultaneously venting the opposite side of the diaphragm to atmosphere through the rotary valve.

OPERATION OF THE FILTER HYDRAULIC CONTROL SYSTEM.–As long as the fuel passing through the filter contains little or no water, the rotary control valve float will remain in its down position. With the float in its down position, the rotary control valve ports are alined as follows: Filter discharge pressure from the clearwell is directed through the rotary valve to the top of the diaphragm of the water drain valve, keeping that valve closed, and to the bottom of the diaphragm in the pilot valve, keeping that valve open. This in turn allows filter discharge pressure to open the automatic shutoff valve.


EDUCTOR
③ PILOT VALVE
(1/2" CLAYTON
POWER-CHECK)
④ SHUT OFF VALVE
(6" CLAYTON HYTROL)
FILTER
SUMP
AV. FUEL
WATER
CONTROL
FLOAT
ROTARY
CONTROL VALVE
A
B
C
C-2
S
D
FLOAT
FLOAT - HORIZ
FLOAT - DOWN
DRAIN
② DRAIN VALVE
(1" CLAYTON
POWERTROL)
GLOBE VALVE

POSITION OF VALVES

FLOAT POSITION	2	3	4
UP	O	C	C
HORIZ.	O	O	O
DOWN	C	O	O

POSITION OF PORTS IN ROTARY CONTROL VALVE

FLOAT PCS	PORTS OPEN TO DRAIN	SUPPLY
UP	C, A	B, C-2
HORIZ.	B, C	A, C-2
DOWN	C-2, B	C, A

198.120

Figure 8-12.—Hydraulic control system operation.

In the down position, the hydraulic control valves are positioned as follows:

1. Pilot valve—OPEN.
2. Automatic shutoff valve—OPEN.
3. Water drain valve—CLOSED.

As coalesced water collects in the filter sump, the float rises to the horizontal position. In the horizontal position, the rotary control valve ports are alined as follows. Filter discharge pressure from the clearwell is directed through the rotary valve to:

1. The bottom of the diaphragm in the automatic water drain valve—this in turn opens this valve and drains the accumulated water overboard.
2. The bottom of the diaphragm in the pilot valve, keeping the pilot valve open—this in turn allows the automatic shutoff valve to remain open.

In the horizontal position, the hydraulic control valves are positioned as follows:

1. Pilot valve—OPEN.
2. Automatic shutoff valve—OPEN.
3. Water drain valve—OPEN.

If a greater amount of water collects faster than it can be drained off, the float will rise to its up position. In the up position, the rotary control valve ports are alined as follows. Filter discharge pressure from the clearwell supply port is directed through the rotary control valve to:

1. The bottom of the diaphragm in the water drain valve, keeping this valve open.
2. The top of the diaphragm in the pilot valve, closing the pilot valve–this in turn causes the automatic shutoff valve to close, stopping the filter discharge.

In the up position, the hydraulic control valves are positioned as follows:

1. Pilot valve–CLOSED.
2. Automatic shutoff valve–CLOSED.
3. Water drain valve–OPEN.

NOTE: It takes a minimum of 10 psi filter pressure to operate the hydraulic control system.

OPERATION OF THE MAIN FUEL FILTER.–JP-5 enters the inlet chamber of the main fuel filter at the bottom. The fuel then passes into the coalescing element, where large solids are retained on the inner walls of the elements. As the JP-5 and water pass through the elements into the fallout chamber, the water (due to the special design of the element) is coalesced into large droplets. These water droplets fall out of the fuel by gravity and into the sump as the fuel passes across the fallout chamber to the separator stage. JP-5 enters the separator elements from the outside and, as it passes through the elements to the outlet (clearwell) section of the filter, the final traces of coalesced water which have not sunk by their own weight are removed, and micron particles (5 micron and larger) are retained on the outer shell. The water drops off the elements and falls to the sump tank by gravity. JP-5 then leaves the outlet section of the filter from the top and flows through the automatic shutoff valve into the fore-and-aft legs of the quadrant.

When putting the filter into operation, the filter vent line should remain open until a solid stream of JP-5 is observed in the bull's-eye glass gage.

CAUTION: It is imperative that the filter shell be properly vented, or full utilization of all the filtering elements will not be realized.

Immediately after a new filter is placed in operation, the pressure gage must be read and logged. A pressure differential between the inlet and fallout chamber should be noted even with new elements. This pressure drop will increase in time because of the buildup of dirt on the inner walls of the coalescing elements.

MONTHLY TEST OF THE FILTER HYDRAULIC CONTROL SYSTEM.–The automatic water drain valve and the automatic fuel shutoff valve are tested monthly for proper operation.

In the event of a malfunction of the hydraulic control system, it is possible to discharge fuel through the water drain and/or pump water through the filter.

The only known method of checking the proper operation of this system is to actually inject clean water into the filter sump and observe the opening of the automatic water drain valve and the closing of the fuel shutoff valve. This is accomplished as follows:

Attach a tee fitting in the pipe plug on the sump. Install a pressure gage to one side of the tee and a globe valve on the opposite side. Connect a water hose from the ship's fire main to the globe valve.

Aline the JP-5 service system to pump from one quadrant to another, bypassing the pressure-regulating valve (on ships so equipped). Start one JP-5 service pump; throttle the globe valve on the discharge side of the service pump to maintain fuel pressure at the filter to at least 25 psi less than the available sea water pressure.

With fuel passing through the filter, slowly admit water into the sump until the drain valve opens or the water level reaches the top of the sump gage glass. If the drain fails to open, secure the system and determine the cause. If the drain valve opens normally, make an indicating mark on the gage glass for future reference and adjust the water flow rate so that the drain valve opens once a minute. Continue testing for 5 minutes.

Without changing the water flow rate, manually close off the water drain line so that no water can drain from the filter sump. If the automatic fuel shutoff valve does not close within 3 minutes, or the water level passes the top of the gage glass on the filter sump, secure the filter and determine the cause.

During this test, take samples in a clean jar from the clearwell chamber to determine the integrity of the separator elements. If the sample from the clearwell is cloudy or contains water, test the separators and replace those found to be dirty or defective. Clean dirty separators before testing.

TROUBLESHOOTING THE FILTER HYDRAULIC CONTROL SYSTEM.–If the automatic control system fails to operate properly, make the following tests:

1. Check the arrows on the automatic shutoff, pilot, and water drain valve to insure proper installation.
2. Insure that all manually operated valves are properly alined.
3. Check the "Y" strainer in the water drain line.
4. Check the rotary control valve supply line strainer.
5. Inspect the copper tubing for flattened, dented, or internal obstructions and replace or clean as necessary.

NOTE: The latter will be the most likely cause of the malfunction. If the above tests prove unsatisfactory, remove the rotary control and float and place it in a vise.

CAUTION: Before disconnecting the copper tubing, tag each one to insure proper replacement.

With the rotary control valve secured in the vise and the float in the down position, blow low-pressure air into the supply port. Air should escape through ports leading to the top of the diaphragm of the water drain valve and to the bottom of the diaphragm of the pilot valve. Raise the float to the mid position; air should escape through ports leading to the bottom of the diaphragm of the water drain valve and the bottom of the diaphragm of the pilot valve. Raise the float to the full up position, and air should escape through ports leading to the bottom of the diaphragm of the water drain valve and the top of the diaphragm of the pilot valve. Blow air through the vent port to insure clear passage. If the rotary control valve fails to pass this test, remove it from the ball float and return it to the factory.

CAUTION: Make no attempt to repair a rotary control valve; special tools and instruments are required to repair this valve.

MAINTENANCE

Daily Operating Checks

Daily operating checks fall into three categories–pressure checks, sample checks, and sump level checks.

PRESSURE CHECKS.–The pressure gages on the inlet, fallout, and clearwell chambers should be read and recorded as indicated in the filter operating log.

As solids build up on the elements, a pressure drop across the filter will develop. The discharge pressure gage will be the lowest of the three; however, the pressure drop across the coalescent stage will be the most critical.

As the maximum allowable pressure drop across the coalescing elements is reached, they will fail to perform their designed function and, therefore, must be replaced.

The maximum allowable pressure drop limits for the coalescing elements will be found on an instruction sheet in the manufacturer's packing crate.

NOTE: An increase in pressure drop across the filter will also affect the proper operation of the Blackmer service stations. This must be corrected accordingly, by increasing the pressure setting on the pressure regulator valve to maintain a constant desired pressure at the discharge side of the filter.

SAMPLE CHECKS.–Daily checks are taken from the filter sump and the filter clearwell section. The contents of each sample should be recorded in the operating log. These samples will determine the condition of the coalescing and separator elements.

If the sample taken from the filter sump contains solids, it is an indication that the coalescing elements have failed and must be replaced.

If the sample taken from the clearwell chamber fails to meet current PMS requirements, it is an indication that the coalescing and/or separator elements have failed and must be inspected, tested, and replaced as necessary.

CAUTION: If the clearwell sample taken immediately after pumping up contains water, this might have been caused by condensation of dissolved water in the fuel when the fuel hit the cold pipes. Drain the service system back below the filter and pump up again, and resample before making a final decision as to the condition of the elements.

Other than the three above-mentioned times (maximum pressure drop limits across coalescent stage is reached, dirty sump sample, and water in the clearwell sample), element replacement is warranted as follows:

1. Contaminated fuel detected in "onboard" aircraft, which can reasonably be assumed to have originated in the ship's fueling system, is considered adequate justification for examining, testing, and replacing filter elements.
2. Coalescing elements should be replaced at each overhaul, and it is recommended that the elements be replaced prior to deployment or at least yearly.

When coalescer elements are changed, the separator elements should be cleaned and tested. Only the defective elements should be replaced and the defective elements discarded.

NOTE: Replacement elements must be tested before installation.

When replacing coalescer elements, do not mix elements of different manufacture since they may have different pressure drop characteristics. Coalescing elements of one manufacturer may, however, be used with separator elements of another manufacturer.

WEEKLY.–Remove the "Y" type strainer from the water drain line and clean as necessary.

MONTHLY.–Remove the strainers from rotary control supply line (clearwell chamber) and clean as necessary.

General Maintenance

Exercise care at all times in opening and closing valves that govern flow through the filter to prevent a hydraulic hammer to the filter. This may cause overstressing of the housing or rupture of the filter elements.

VERTICAL FILTERS

A vertical filter is shown in figure 8-13. The only noted differences between the vertical and horizontal filters, other than the two previously mentioned (physical shape and direction of flow), are the hydraulic control system and pressure gage arrangement.

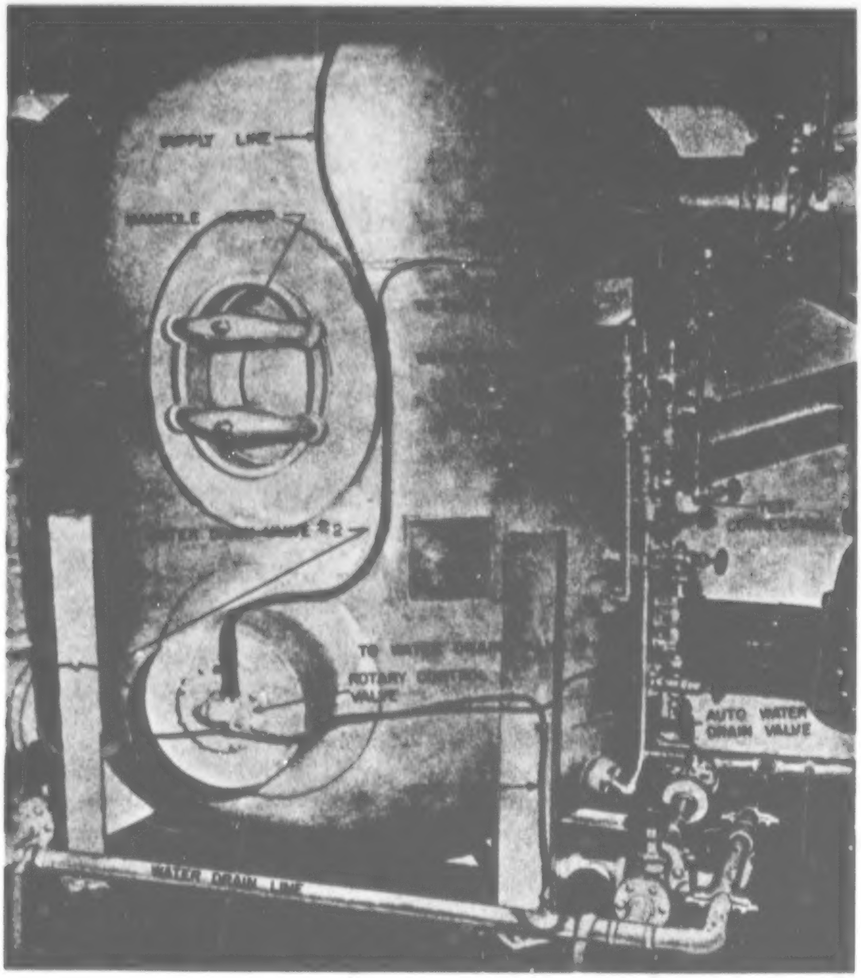
The hydraulic control system for vertical filters differs only in the construction and operation of the automatic water drain and pilot valves and the location and number of ports in the rotary control valve.

The automatic water drain and pilot valves are constructed identically (except for physical size) as the automatic fuel shutoff valve (fig. 8-14) and operate on the same principle. When fuel pressure is applied to the top of the diaphragm, the valve closes, and fuel pressure acting on the bottom of the valve disk (with the diaphragm cover chamber vented) opens the valve. Both valves serve the same identical purpose in respect to the water drain and pilot valves on the horizontal filters.

With the installation of this new type valve in the hydraulic system, it eliminated the need for two of the ports in the rotary control valve. These two ports are the ones required to open the water drain and pilot valves in the horizontal filters.

The rotary control valve is flanged to the side of the filter shell. It is actuated by the rise and fall of a captivated ball float housed within the fallout chamber (the lower section of the fallout chamber is in reality the filter sump) on vertical type filters. This valve functions in the same manner and for the same purpose as the rotary valve in the horizontal filters, the only difference being, it has only four ports:

1. Supply (from the clearwell section).
2. Vent (to atmosphere).


SUPPLY LINE
MANHOLE COVER
WATER DRAIN VALVE #2
TO WATER DRAIN
ROTARY CONTROL VALVE
TEST CONNECTIONS
AUTO WATER DRAIN VALVE
WATER DRAIN LINE

197.31.1

Figure 8-13.—Vertical aviation fuel filter.

3. To the top of the diaphragm in the pilot valve.
4. To the top of the diaphragm in water drain valves.

NOTE: The 2,000 gpm vertical filters have two automatic water drain valves. These valves are opened and closed simultaneously. A tee fitting is installed in the rotary control valve port to facilitate attaching both valves to one port.

With the float in the down position, the fuel discharge valve is open, and the water drain valve is closed. When the float moves to mid-position the fuel discharge valve remains open, and the water drain valve opens. When the float moves to the up position the fuel discharge valve closes, and the water drain valve remains open.

A reflex type sight glass gage is installed on the side of the filter shell, at the bottom of the fallout chamber. This gage is used to determine the water level within. During the Monthly

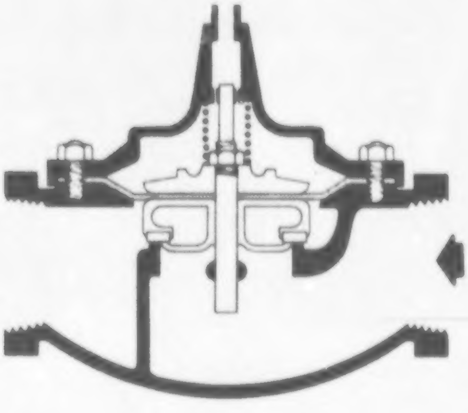


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Figure 8-14.—Automatic fuel shutoff valve.

water slug test (described under horizontal filters) the sight glass gage should be marked to indicate at what level the water drain valves open, and at what level the fuel discharge valve closes. During normal operations the water level should be monitored frequently.

Pressure Gages

There are only two pressure gages installed for determining the fuel pressure across the vertical filters—a differential pressure gage and an outlet pressure gage.

The differential pressure gage is used to determine the pressure drop through the coalescing elements. This gage is connected by two lines—one from the inlet chamber and one from the fallout chamber. The difference between these two pressures is indicated on the gage. Any increase in pressure drop across the coalescing elements (caused by the collection of solids) will be indicated on this gage.

The outlet pressure gage is attached to the discharge piping. This gage is used to determine the pressure of the fuel after it has passed through the separator elements and before it is discharged past the automatic fuel shutoff valve. If the outlet pressure shows a considerable drop, and the differential gage shows no increase, replace the separator elements.

FIRST-STAGE FILTER

As a safeguard against contamination, JP-5 is never received into service tanks from a hangar deck filling connection. JP-5 is received into stowage tanks, settled, and then pumped through a filter to service tanks. (See fig. 8-15.)

NOTE: The fuel/water separator filter described here has been replaced by centrifugal separators on most CVA's.

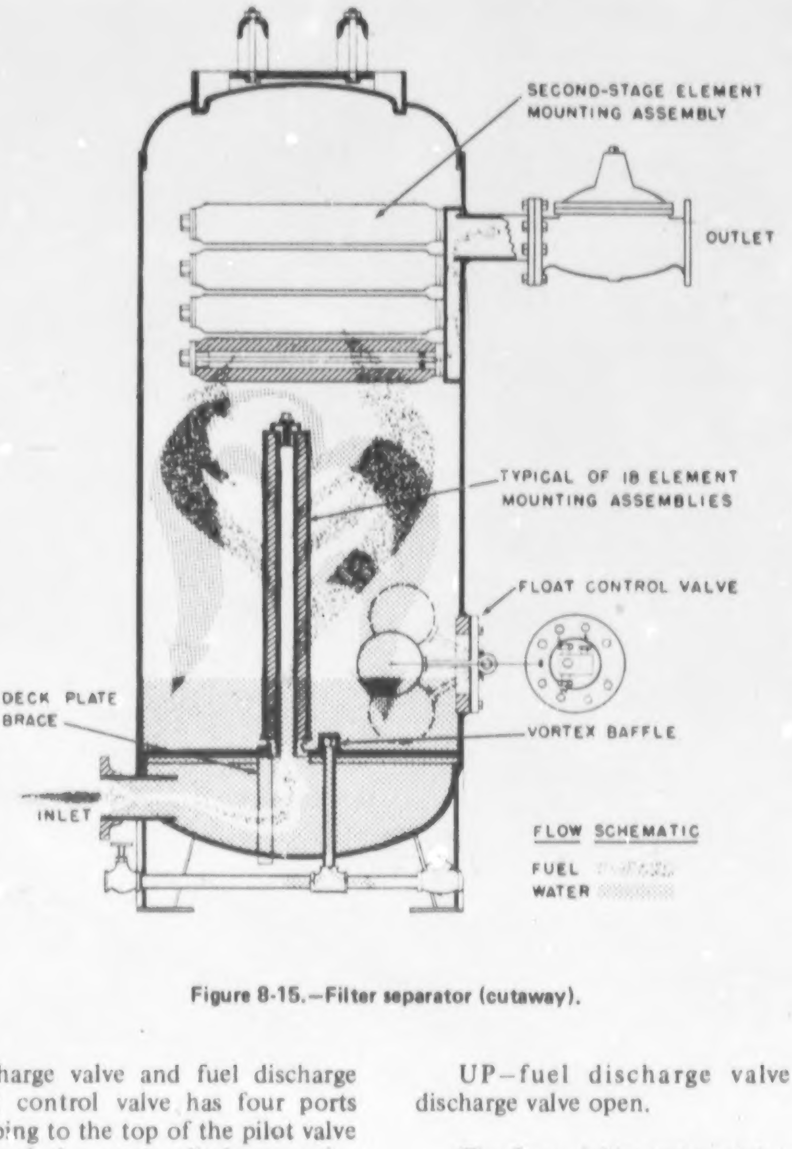
First-stage filters are located between the transfer pump and service tanks. The first-stage filter described here is manufactured by the Briggs Filtration Co. It has a rated capacity of 300 gpm (orificed to 200 gpm), and a working pressure of 100 psi. The filter is designed to remove 98 percent by weight of all solids, 5 microns or larger, and 99.9 percent of the water. The unit has a cylindrically shaped, welded, coppernickel shell mounted on three legs. A bolted hand hole cover assembly at the top of the shell provides access to remove or replace separator and coalescer elements. The interior of the shell is divided into three chambers—inlet, fallout, and outlet. The inlet chamber is at the bottom of the shell, the fallout chamber contains coalescer and separator cartridges, and the outlet chamber (clearwell) connects to the discharge piping.

The outside of the shell contains a sight gage, differential gage, and outlet pressure gage. The reflex type sight level gage indicates water level in the fallout chamber. The differential gage indicates the pressure drop across the coalescing stage. The outlet gage indicates the pressure of the filtered fuel after it has passed through the separator elements and before it leaves the filter.

The coalescing stage consists of 18 coalescing elements mounted vertically on the horizontal deck plate. Fuel flows from the inlet chamber through the coalescing elements to the fallout chamber.

The separatory stage consists of 11 separator elements, mounted horizontally in individual mounting assemblies, attached to the outlet chamber. Fuel flows from the fallout chamber through the separator cartridges to the outlet chamber.

A float control valve, bolted to a flange which is welded to the shell, controls the action


SECOND-STAGE ELEMENT MOUNTING ASSEMBLY
OUTLET
TYPICAL OF 18 ELEMENT MOUNTING ASSEMBLIES
FLOAT CONTROL VALVE
DECK PLATE BRACE
VORTEX BAFFLE
INLET
FLOW SCHEMATIC
FUEL
WATER

197.54

Figure 8-15.—Filter separator (cutaway).

of a water discharge valve and fuel discharge valve. The float control valve has four ports connected by tubing to the top of the pilot valve diaphragm, top of the water discharge valve diaphragm, the fallout chamber, and a vent port to the discharge side of the water discharge valve. The float control valve has three positions—down, mid, and up.

DOWN—fuel discharge valve open; water discharge valve closed.

MID—fuel discharge valve open, water discharge valve open.

UP—fuel discharge valve closed; water discharge valve open.

The float, calibrated to sink in JP-5 and float on water, is located in the fallout chamber.

The water discharge valve automatically drains water from the fallout chamber, with the float in the mid or up position. It is held closed by filter fallout pressure to the top of the diaphragm when the float is down, and opened by filter fallout pressure under the disk with the float in mid or up position. A manual drain line permits bypassing of the water drain valve if the valve is inoperative.

The pilot-operated fuel discharge valve is identical in construction and operation to the automatic shutoff valve discussed in the preceding section except for size. The pilot valve is opened by filter discharge pressure under the disk, with the float in the down or mid position, and closed by filter discharge pressure through the float control valve to the top of the diaphragm, with the float up. As long as the pilot is open, the fuel discharge valve remains open. When the pilot valve closes, the fuel discharge valve closes.

Filtering, separating, and discharge actions are automatically controlled when fuel under pressure is introduced. Operating pressures should be logged as soon as possible after putting the unit in operation. The differential and outlet pressure gages should be checked regularly during operations.

Replace coalescer elements when the pressure drop reaches the manufacturer's specified limit. Replace the separator elements if the outlet pressure shows a considerable drop while the differential gage shows no marked increase. When 400,000 gallons of JP-5 have passed through the filter, replace the coalescer elements, and clean and test the separator elements, replacing only the defective ones.

NOTE: Replacement elements must be tested before installation.

Liquid level in the unit can be seen in the sight gage. When enough water has accumulated to raise the float and open the water discharge valve, the level should be marked on the sight gage. This will enable the operator to detect any unusual conditions during subsequent operations.

NOTE: The first stage filters described here are similar to the 300 gpm and 400 gpm installed on the LPH and LPD class ships.

CENTRIFUGAL PURIFIER

Centrifugal force is defined as that force which impels a thing (and any or all of its parts) outward from a center of rotation. Every time you lean in as you take a fast turn, you are counterbalancing centrifugal force. How far in you lean is determined by the amount of centrifugal force exerted in the turn. Most people do it automatically, for centrifugal force, along with gravity, is the most prevalent physical force exerted upon us--and upon all matter.

If it is moving and if it is turning, it is generating centrifugal force. The amount of centrifugal force is determined by specific gravity, the degree of the curve, and the speed of travel.

The efficiency and purifying ability of any centrifuge is determined by the construction and operation of the most vital part—the bowl. It employs the principles of thin-strata distribution and the balanced column.

The centrifugal bowl is equipped with a series of conical-shaped disks which divide the feed material into layers, usually not more than 50/1,000 inch in thickness. Note the paths of travel in the diagrammed enlargement of the interdisk spaces, figure 8-16. The heavy phase liquid and any solids present travel outward along the underside of the intermediate disks, forced outwardly by centrifugal force because of greater density. Reaching the outer edge of the disks, the heavy-phase liquid is forced upward by displacement, and the solids are thrown

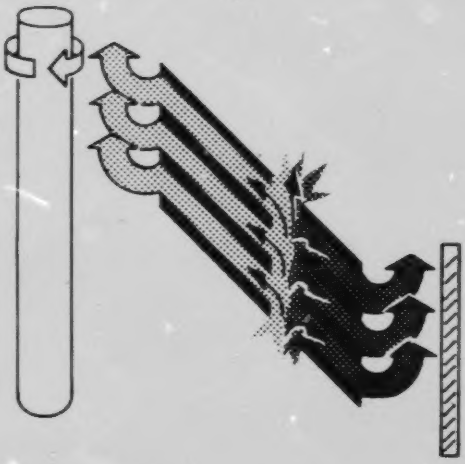


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Figure 8-16—Diagrammed enlargement of the interdisk spaces.

directly to the bowl wall where they collect until removed. The light-phase liquid is displaced inwardly and travels along the upper side of the intermediate disks. When it reaches the inner edge of the disk, displacement forces it upward and out through the appropriate discharge outlet.

The holes in the disks are the feed channels for the incoming, mixed liquid. They can be located at points ranging from near the outer edge of the disks to close to the inner edge. Upwards of 80 percent purification occurs immediately as the feed material is distributed through the holes. The location of the holes in the disks determines which phase shall benefit from the most purifying action after distribution. When the holes are located near the outer edge, the light phase benefits from the greatest purifying action, having the longest distance to travel under centrifugal force. When the holes are close to the inner edge, the reverse is true.

As the feed material is separated into its light and heavy phase, the heavy phase is forced towards the bowl wall and the lighter phase displaced inwards. The level of the still-mixed feed material is controlled by the height of a dam for the heavy phase. This dam is called a discharge ring.

The larger the opening, the nearer to the outer edge of the disks is the neutral zone. This setup renders the maximum purification to the light phase and is used typically in purification of oil with water contamination; water is heavier than oil and it is desirable that the oil benefit from the most purification.

Disk holes are located relative to the location of the neutral zone. This is the area of the still-mixed liquid, and initial separation occurs immediately as the feed material is distributed through these openings.

The purpose of the centrifugal purifier (fig. 8-17) in the JP-5 filling and transfer system is to separate and remove water, solids, and emulsions from JP-5 during transfer from stowage to service tanks. The diskbowl centrifuge is a "constant efficiency" type of separator; that is, it achieves the same degree of efficiency at the end of a run as at the beginning. The reason for the constant efficiency is that accumulated solids are stowed away from the separation zone. Separation occurs within the disk spaces and the separated liquids are discharged from outlets which are removed from interference of the stowed solids.

As previously mentioned, the centrifugal purifiers have replaced the first-stage filters in the JP-5 filling and transfer system on most CVA's. This replacement is on a unit-for-unit basis; i.e., one purifier replaces one transfer filter.

Characteristics of purifier B214A (Navy Size JF-2) are:

1. Capacity-200 gpm at 60° F to 90° F when purifying JP-5 (fuel temperature).
2. Feed inlet pressure–9 psi.
3. Back pressure of the discharged JP-5:

   Minimum–25 psi.
   Ideal–30 psi.
   Maximum–33 psi.

4. Bowl speed–4,100 rpm.

NOTE: Feed pumps and connecting piping are not integral parts of this purifier.

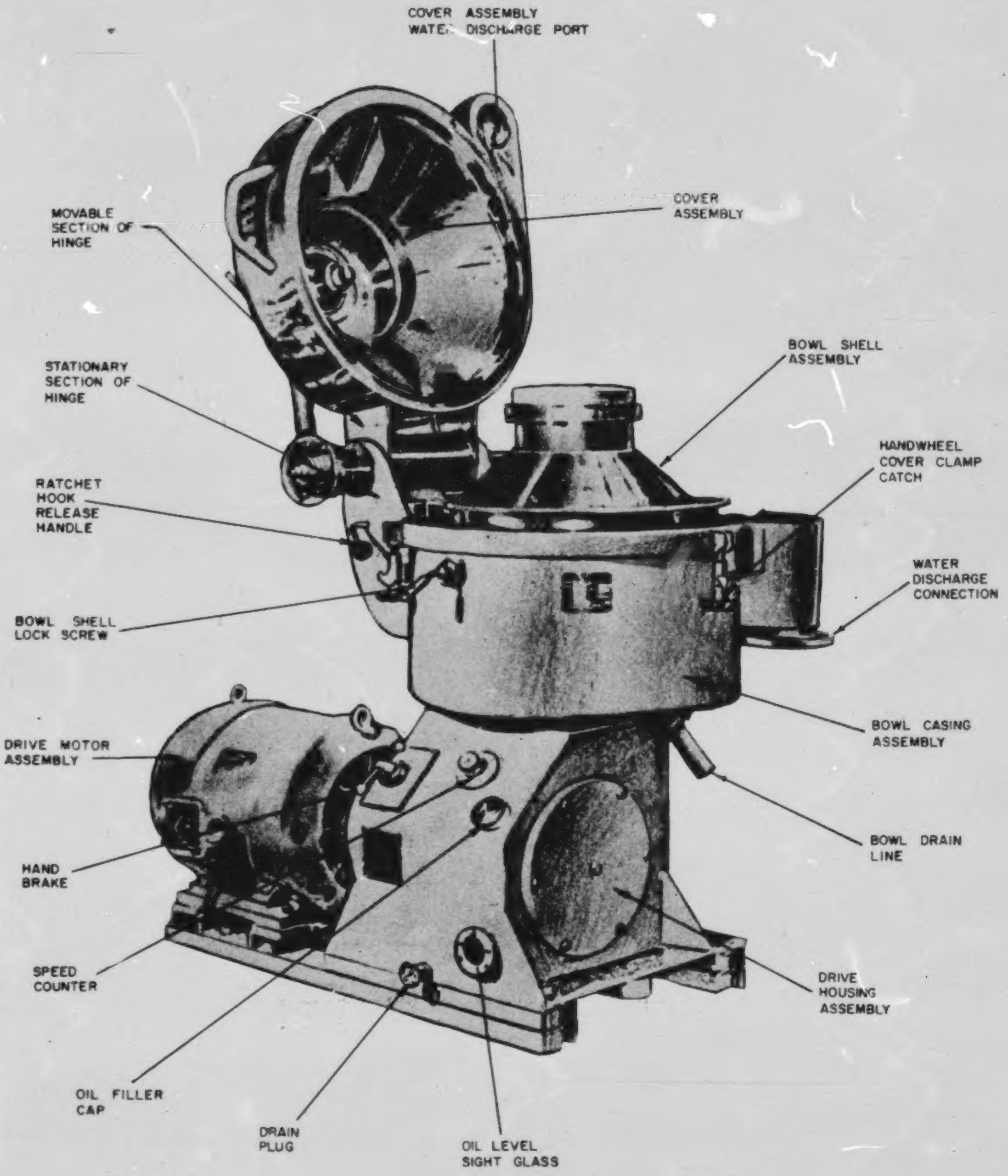
The entire unit is mounted to a common base plate. The base plate is shock mounted to the ship by means of six rubber cushions–three on each side.

A detailed description of the five basic assemblies is given in this section before operating and maintenance instructions are covered.

COVER ASSEMBLY

The cover completely encloses the top of the rotating bowl shell assembly. This cover hinges to the bowl casing, thus allowing the cover to be rotated out of the way for disassembly and cleaning of the bowl. (See figs. 8-17 and 8-18.)

The cover hinge, inlet, and outlet assembly functions to allow the cover to be opened without disconnecting the piping. The stationary part of the hinge is welded to the bowl casing. The movable part of the hinge is welded to the cover. A ratchet hook is provided on the stationary part of the hinge to lock the cover in the open position. A handle is provided to unlock the hook so that the cover can be closed.


COVER ASSEMBLY WATER DISCHARGE PORT
COVER ASSEMBLY
MOVABLE SECTION OF HINGE
BOWL SHELL ASSEMBLY
STATIONARY SECTION OF HINGE
HANDWHEEL COVER CLAMP CATCH
RATCHET HOOK RELEASE HANDLE
WATER DISCHARGE CONNECTION
BOWL SHELL LOCK SCREW
BOWL CASING ASSEMBLY
DRIVE MOTOR ASSEMBLY
BOWL DRAIN LINE
HAND BRAKE
SPEED COUNTER
DRIVE HOUSING ASSEMBLY
OIL FILLER CAP
DRAIN PLUG
OIL LEVEL SIGHT GLASS

198.62

Figure 8-17.–Front view of purifier (cover open).

Inlet and outlet piping connects through the hinge to the inlet and outlet tubes. The piping is stationary; the tubes rotate with the cover. A chevron-shaped, oil-resistant rubber seal is installed between the piping and tubing to prevent leakage. Fuel pressure spreads the chevron rings to make a tight seal. When fuel flow is stopped, pressure ceases and the chevron seals loosen enough to allow the cover to be rotated to the open position.

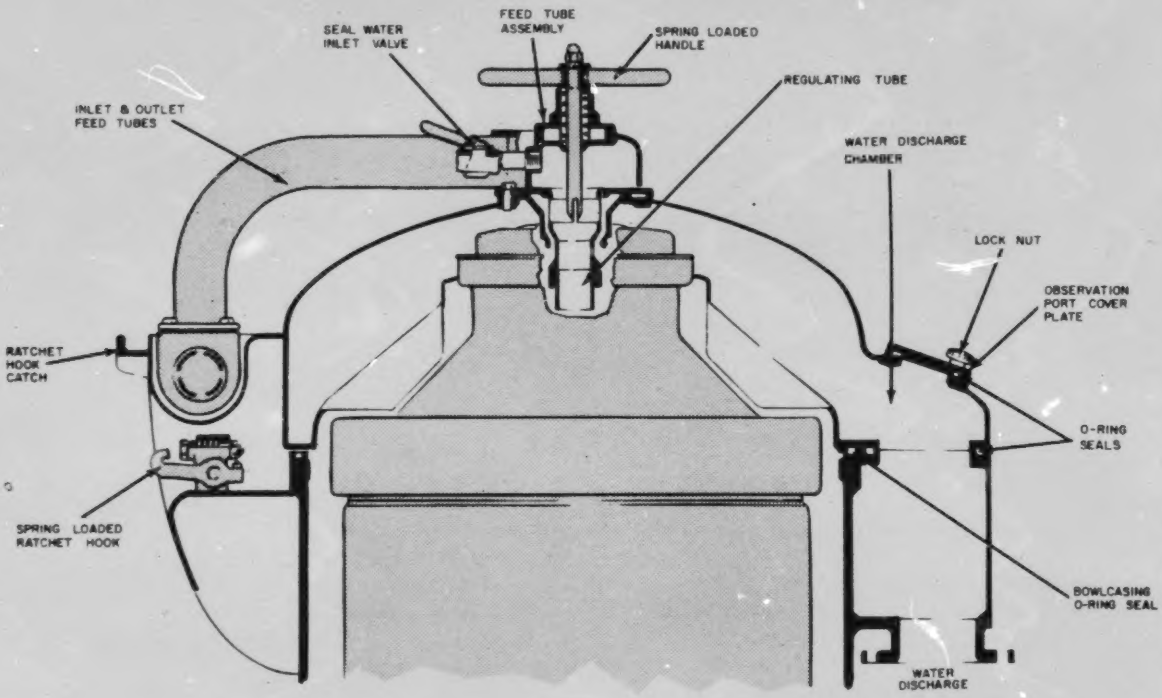
The feed inlet tube and the purified JP-5 discharge tube both connect into the feed tube assembly at the top of the cover. An oil-resistant seal (O-ring) prevents leakage of liquids between each tube and the feed tube assembly. The feed tube assembly directs feed into the revolving bowl and purified JP-5 out of the bowl. A thermometer is installed on the feed tube assembly to indicate the feed inlet temperature.

A seal water inlet, located between the inlet and discharge tubes, directs fresh water into the revolving bowl for use as a seal. A ¾-inch plug valve and flexible rubber hose connect the seal water inlet to the fresh water supply in the pumproom.

Internally, the feed tube assembly is constructed so as to direct the feed and the seal water to a nylon regulating tube, via the thermometer. The regulating tube then directs this liquid to the center of the tubular shaft (part of the bowl shell assembly).

NOTE: Nylon is used as the bearing and sealing material between certain rotating and stationary parts, thus preventing sparking and excessive heat which might otherwise be caused by metal-to-metal contact.

The regulating tube is also the shaft for the paring disk (impeller). The spring-loaded handle, extending out the top of the feed tube assembly, is utilized to screw the regulating tube into the paring disk. The handle remains down when the


SEAL WATER INLET VALVE
FEED TUBE ASSEMBLY
SPRING LOADED HANDLE
REGULATING TUBE
INLET & OUTLET FEED TUBES
WATER DISCHARGE CHAMBER
LOCK NUT
OBSERVATION PORT COVER PLATE
RATCHET HOOK CATCH
O-RING SEALS
SPRING LOADED RATCHET HOOK
BOWLCASING O-RING SEAL
WATER DISCHARGE

198.63

Figure 8-18.—Bowl cover assembly (cutaway).

two are engaged. When not engaged, the spring forces the handle and regulating tube up and away from the paring disk.

CAUTION: The regulating tube has left-hand threads. The regulating tube must be disengaged from the paring disk before the cover can be opened.

Equally spaced around the bottom of the cover are three handwheel cover clamp catches. These hook-shaped catches are utilized to lock the cover in the closed position.

Inside the dome-shaped cover is the water-discharge chamber. This chamber normally receives the water discharged from the revolving bowl. This water is directed to the water-discharge outlet area of the water-discharge chamber. An observation port is provided to facilitate a visual check of the discharging water. The port has a metal cover which is swung to one side when it is opened. The port, when open, is just a hole. No glass or other transparent medium is provided to cover the open port.

BOWL CASING

The bowl casing is a circular stationary tub which houses the rotating bowl shell assembly. The stationary part of the cover hinge, inlet, and outlet assembly is welded to the outside of the bowl casing.

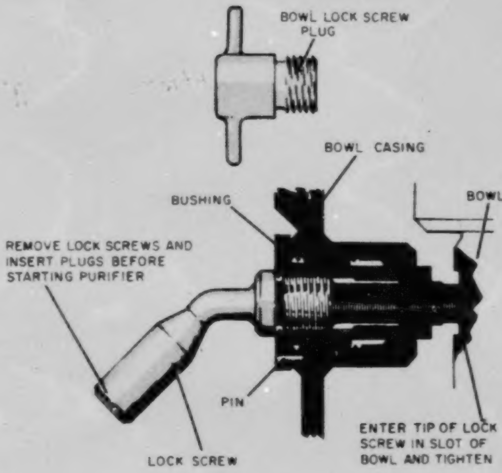
Three handwheel cover clamps are equally spaced around the top of the bowl casing to lock the cover in the closed position. Each handwheel cover clamp has a hook which engages the catch on the cover. Rotating the handwheel screws the hook down upon the catch, which in turn pulls the cover down. Handtight is sufficient for proper locking of the cover in the closed position.

A large oil-resistant ring provides a liquid-tight seal between the cover and the bowl casing when the cover is closed.

Two bowl shell lock screws (fig. 8-19) are housed in the upper part of the bowl casing. These locking devices lock the bowl shell assembly during disassembly and assembly. They are engaged to prevent the bowl shell assembly from rotating. A threaded bushing in the bowl casing allows the lock screws, which are also threaded, to be screwed into or out of the lock position. When the lock screws are in the lock position, they engage a slot in the revolving bowl shell assembly.

CAUTION: The two bowl shell lock screws must be removed before starting the purifier. Two bowl shell lock screw plugs are provided to plug up the threaded hole in the bowl casing when the lock screws are removed. The lock screw plugs are much shorter than the lock screws and, therefore, eliminate the possibility of engaging the slots in the revolving bowl shell during operation. If the lock screws are not completely removed and the lock plugs installed before starting, vibration could cause the lock screws to engage the slots in the rapidly revolving bowl shell.

A water-discharge connection is welded to the upper portion of the bowl casing. This connection is alined with the water-discharge connection in the cover assembly when the cover is closed. An oil-resistant O-ring forms a liquid-tight seal between the water-discharge connections of the cover and bowl casing when the cover is closed. The lower end of the bowl casing's water-discharge connection is flanged to the water-discharge line.


BOWL LOCK SCREW PLUG
BOWL CASING
BUSHING
BOWL SHELL
REMOVE LOCK SCREWS AND INSERT PLUGS BEFORE STARTING PURIFIER
PIN
LOCK SCREW
ENTER TIP OF LOCK SCREW IN SLOT OF BOWL AND TIGHTEN

198.64

Figure 8-19.–Bowl shell lock screw and plug.

The water-discharge line directs water into a sump tank. The water-discharge line contains a flexible pipe connection between the purifier and the connecting piping that is firmly braced to the ship's structure. This flexibility allows for safe passage through the critical vibration range when starting and stopping the purifier. A sight flow gage and flapper are installed in this line to provide a visual and audible check of discharging water.

A bowl casing drain line protrudes from the bottom of the bowl casing. This line facilitates draining any liquid that may enter the annular space between the revolving bowl shell assembly and the stationary bowl casing. A locked-open globe valve is installed in this line. It is imperative that this valve be open prior to starting and during starting, operating, and stopping cycles of the purifier. The bowl casing drain line directs drained liquid into the sump tank. A short length of rubber hose is installed in this line to perform the same function as the flexible pipe connection in the water-discharge line.

DRIVE HOUSING AND ASSEMBLIES

The drive housing bolts to and supports the bowl casing, cover, and bowl shell assembly. The drive housing houses the spindle assembly, clutch assembly, speed counter, brake, and lubrication system.

The spindle assembly (fig. 8-20) is the vertical drive shaft for the bowl shell assembly. Three sets of ball bearings support the spindle assembly—a set at the top, a set at the center, and a set at the bottom. All three sets of ball bearings are lubricated by oil. Located between the upper and lower bearings of the center set of ball bearings is a large vertical spring. This spring acts as a shock absorber to absorb any vertical thrust of the spindle's shaft when the purifier is started. Six equally spaced horizontal springs surround the upper set of ball bearings. These springs absorb and cushion any horizontal movement of the bowl shell assembly and thus reduce vibration. The lower end of the spindle's shaft is geared to the horizontal drive shaft of the clutch assembly.

NOTE: The spindle assembly is removed for maintenance ONLY.

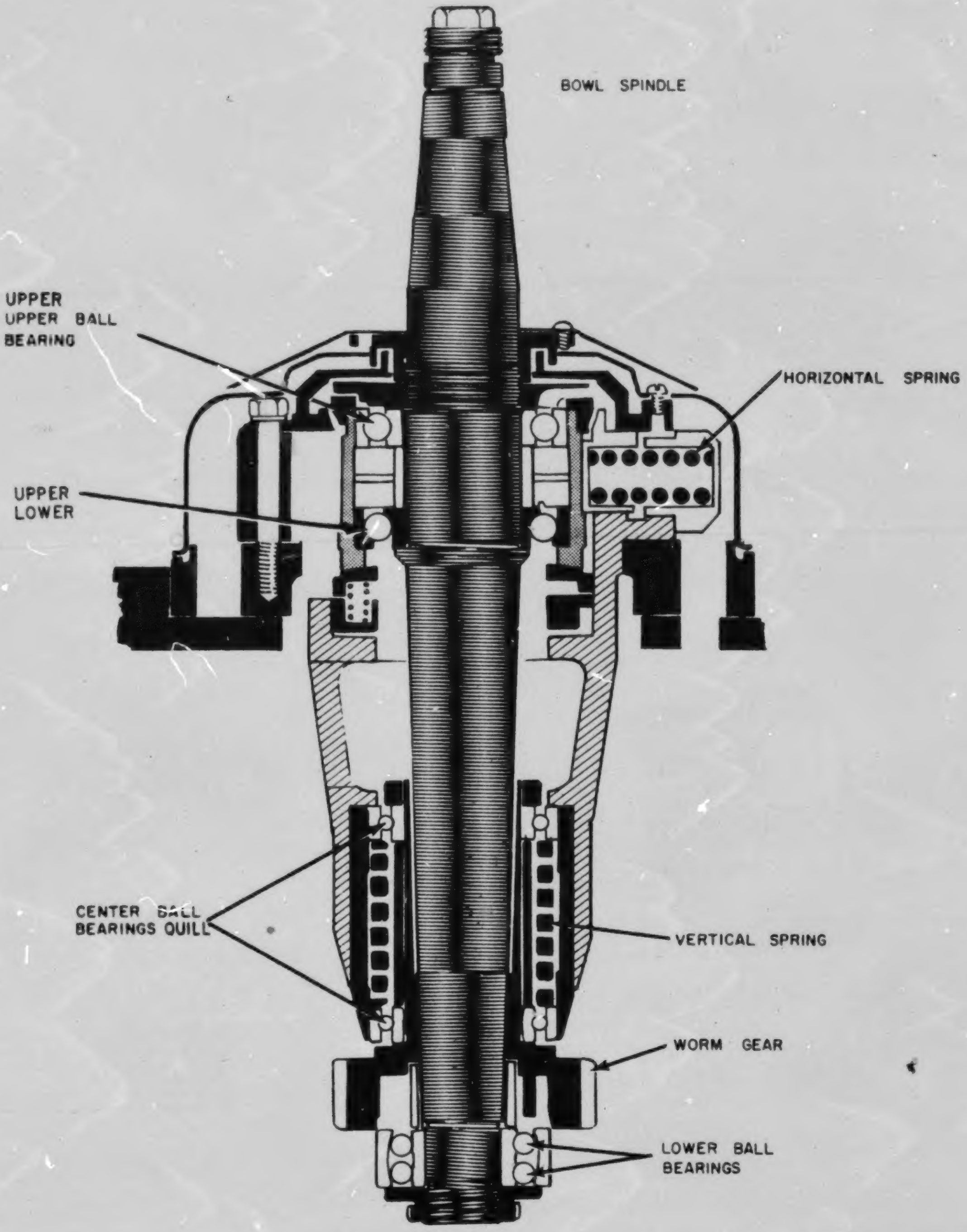
The clutch assembly transmits drive motor power to the spindle, which, in turn, transmits power to the bowl shell assembly. The clutch assembly (fig. 8-21 (A) and (B)) is a centrifugal type clutch that consists of two basic subassemblies—drive motor end and purifier end.

The drive motor end has four friction weights. These friction weights pivot on pins which are equally spaced around a hub. Each friction weight has a composition lining which is similar to the brake lining of an automobile. As the drive motor rotates, the four friction weights are thrown outward by centrifugal force and rotate at the same speed as the drive motor. The rotating friction weights come in contact with the inner surface of the sleeve/housing of the purifier end of the clutch. Friction created by the friction weights, and their lining rubbing against the sleeve, causes the purifier end of the clutch to rotate.

The purifier end of the clutch has a sleeve/housing which is attached to a horizontal drive shaft. The drive shaft is supported by two ball bearings—an outer and an inner bearing. Two smaller bearings of the same type are located between the small end of the shaft and the friction clutch. The outer and inner shaft bearings are lubricated by oil. The friction clutch bearings are lubricated by packing with grease. A worm wheel gear is keyed to the drive shaft. This gear engages the gear at the base of the spindle assembly. A smaller gear, which is part of the worm wheel gear, is utilized to drive a speed counter.

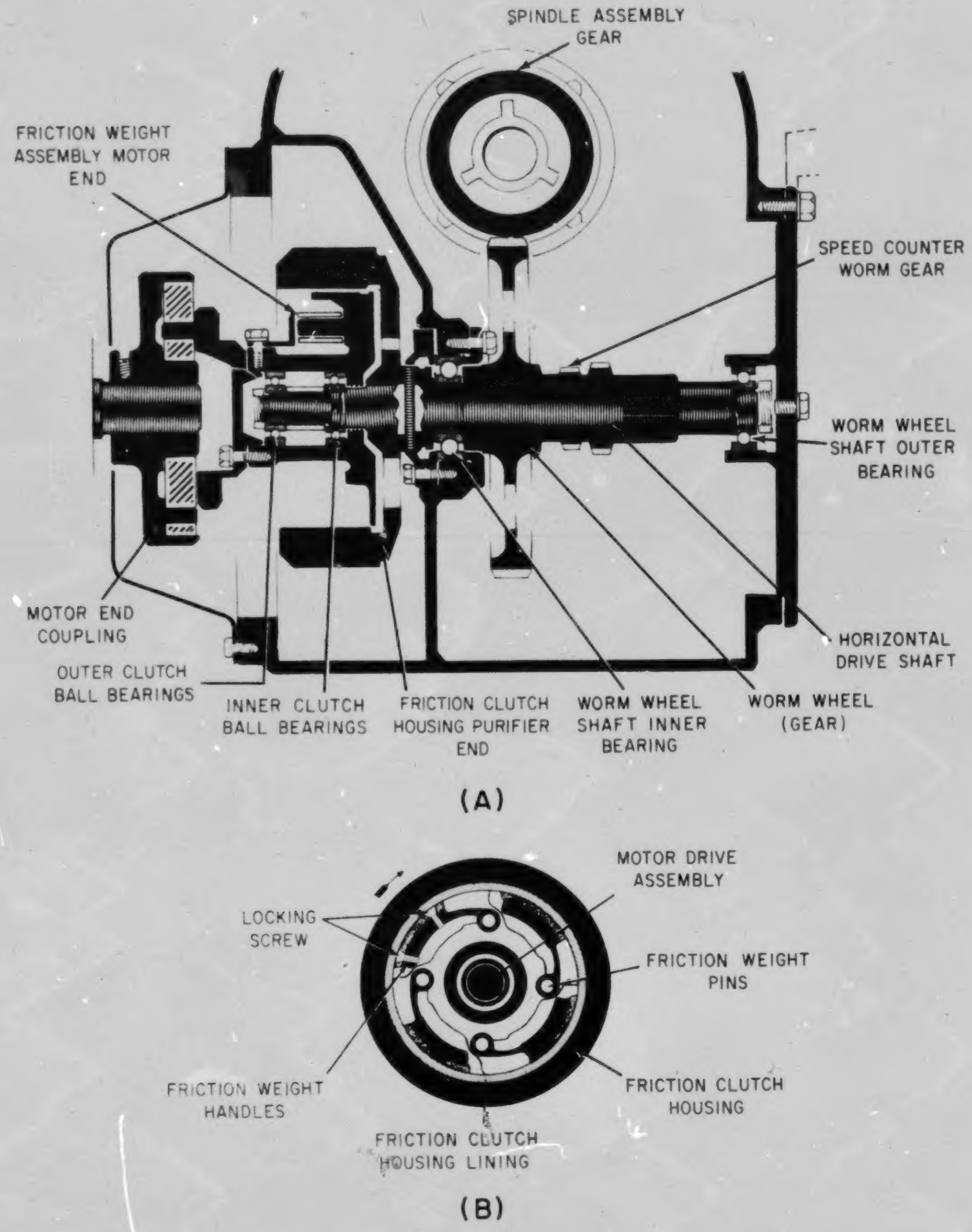
Some models of purifiers have a direct drive assembly installed in place of the friction clutch hub (fig. 8-22). The purifier is connected to the motor shaft by a flexible coupling consisting of two coupling havles; the motor end coupling is fitted to the motor, and the machine end coupling is fastened to the brake drum with four bolts. A rubber cushion is installed between the two coupling halves.

The speed counter (fig. 8-23) is used to determine the rpm of the bowl shell assembly. Basically, it consists of a shaft which penetrates the drive housing. One end is inside the drive housing and the other end is outside. The inside end is geared to the worm wheel gear; therefore,


BOWL SPINDLE
UPPER
UPPER BALL
BEARING
HORIZONTAL SPRING
UPPER
LOWER
CENTER BALL
BEARINGS QUILL
VERTICAL SPRING
WORM GEAR
LOWER BALL
BEARINGS

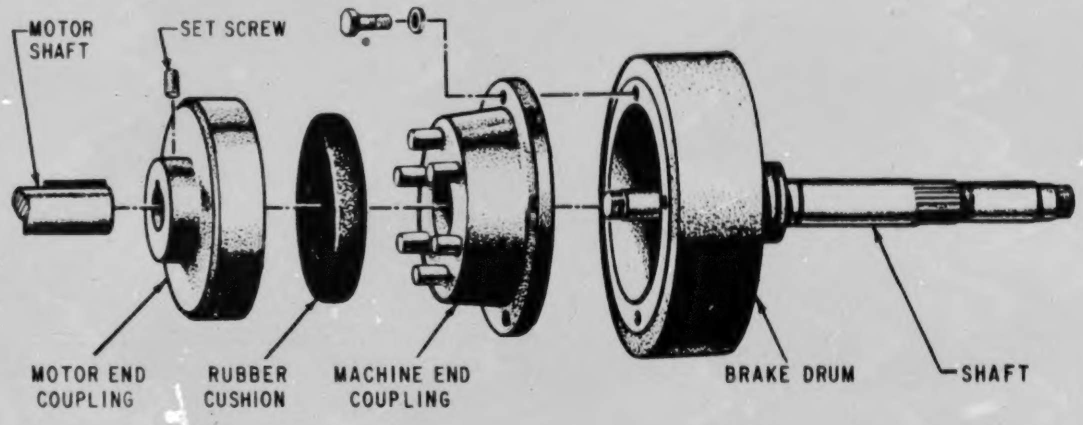
198.65

Figure 8-20.–Bowl spindle assembly.


SPINDLE ASSEMBLY GEAR
FRICTION WEIGHT ASSEMBLY MOTOR END
SPEED COUNTER WORM GEAR
WORM WHEEL SHAFT OUTER BEARING
MOTOR END COUPLING
HORIZONTAL DRIVE SHAFT
OUTER CLUTCH BALL BEARINGS
INNER CLUTCH BALL BEARINGS
FRICTION CLUTCH HOUSING PURIFIER END
WORM WHEEL SHAFT INNER BEARING
WORM WHEEL (GEAR)
(A)
MOTOR DRIVE ASSEMBLY
LOCKING SCREW
FRICTION WEIGHT PINS
FRICTION WEIGHT HANDLES
FRICTION CLUTCH HOUSING
FRICTION CLUTCH HOUSING LINING
(B)

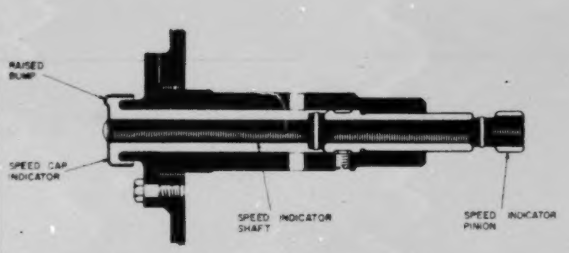
198.66/67

Figure 8-21.–Clutch assembly: (A) bottom view; (B) end view.


MOTOR SHAFT
SET SCREW
MOTOR END COUPLING
RUBBER CUSHION
MACHINE END COUPLING
BRAKE DRUM
SHAFT

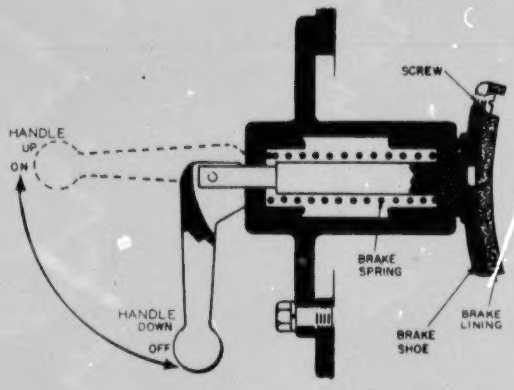
198.68

Figure 8-22.–Direct drive assembly.


RAISED BUMP
SPEED CAP INDICATOR
SPEED INDICATOR SHAFT
SPEED INDICATOR PINION

198.69

Figure 8-23.–Speed counter assembly.


SCREW
HANDLE UP ON
BRAKE SPRING
HANDLE DOWN OFF
BRAKE LINING
BRAKE SHOE

198.70

Figure 8-24.–Brake assembly.

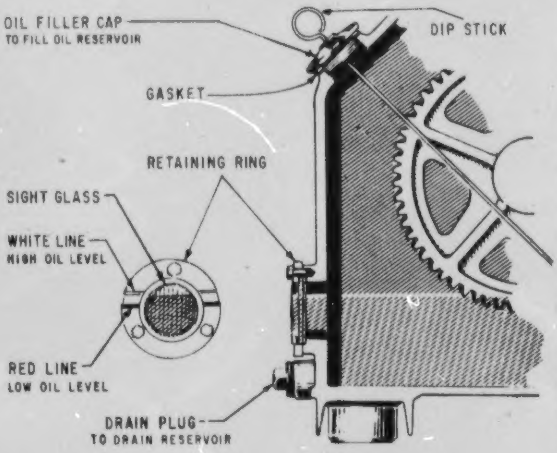
when the clutch shaft rotates, the speed counter shaft rotates. The speed counter, however, rotates at a much slower rate because of the gear ratio. The outside end of the speed counter shaft is covered by an attached cap. The cap has a raised bump on one side of its top. Bowl speed is determined by the operator who places his finger on the outer edge of the cap and then counts the number of times the raised bump touches his finger in one minute. During full bowl rpm, the count should be between 146 and 150 times per minute.

It must be pointed out here that because of the gear ratio, the drive motor rotates at 1,770 rpm, the bowl rotates at 4,100 rpm, and the speed counter rotates at 146 to 150 rpm. A handbrake (fig. 8-24) is provided to stop the purifier. This brake is for emergency use only. Basically, it consists of a spring-loaded brakeshoe and an eccentric handle. The brakeshoe has a replaceable section of bonded brake lining. When the handle is down, the brake is off. When the handle is raised to the up position, the brake is on. In the on position, the spring forces the brakeshoe and lining against the outer surface of the sleeve/housing of the purifier end of the clutch assembly. Friction, thus created, causes the purifier to come to a stop.

In the base of the drive housing is an oil sump for the oil lubrication system (fig. 8-25). All of the bearings on the spindle and one of the two sets of bearings on the clutch drive shaft are lubricated by this oil. The remaining set of bearings on the clutch shaft is lubricated by grease. The drive housing is divided into two compartments. One of these compartments contains the clutch assembly and the other contains the gears and bearings that are lubricated by oil. A metal partition separates the two compartments. The clutch drive shaft passes through this partition. A gasket is installed around the clutch drive shaft to prevent oil from entering the clutch compartment. The worm wheel gear on the clutch drive shaft is partially submerged in the oil. Rotation of this gear splashes the oil about within the oil lubrication compartment, thus supplying oil to the bearings and gears. The oil sump holds from 8 to 8½ quarts of grade 90 gear oil. Proper oil level is determined by a circular sight glass on the side of the drive housing. The glass retaining ring has two inscribed lines to indicate proper oil level. The top line, which is white, is the high or full oil level. The bottom line, which is red, is the low oil level mark.

On some installations where the oil sight gage could not be seen easily in its normal position, the sight glass has been extended out and turned to give a clear view to the operator, or a dip stick has been added to the oil filler cap (fig. 8-25). The dip stick has two marks. The lower mark indicates lubricating oil should be added; fill to the upper mark. To check the oil level, pull the stick completely out through the cap. Wipe with a clean, dry rag. Push the stick all the way in through the cap and pull it out again to read. Be sure the stick always rests on the cap.

An oil fill cap is located near the top of the drive housing. An oil drain plug is located at the base of the oil sump (fig. 8-25).



198.71

Figure 8-25.—Oil lubrication.

BOWL SHELL ASSEMBLY

The bowl shell assembly (fig. 8-26) provides the working area for separation of contaminants from JP-5. The entire bowl shell assembly sits on top of the spindle assembly. The spindle assembly causes the bowl shell assembly to rotate. This rotation is transmitted to the fuel, thus providing the necessary centrifugal force to cause separation to take place. During operation, the bowl shell assembly contains a fresh water seal to prevent loss of the JP-5. Most of the separated solids and emulsions are retained within the bowl shell assembly, but are completely removed from the line of flow of the liquids.

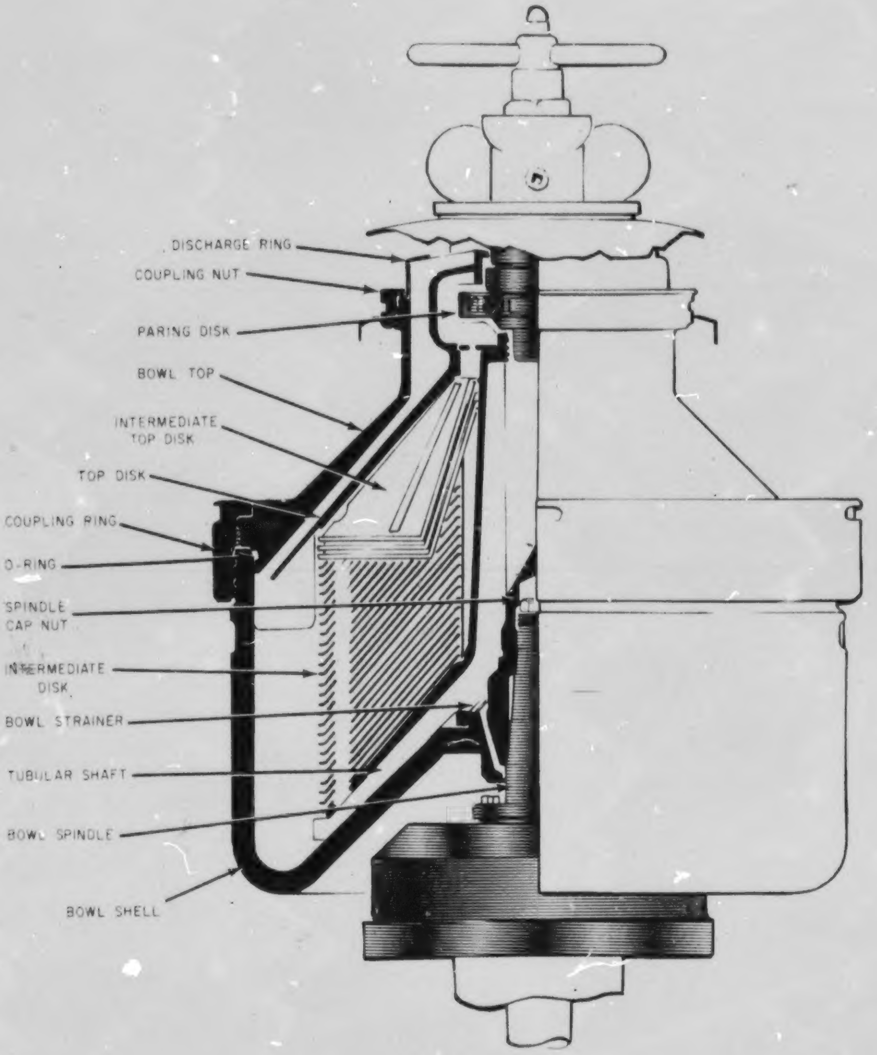
The bowl shell contains 11 component parts which are described in the following pages.

The bowl shell confines the liquids being separated. Housed within the "tub-like" bowl shell are the strainer, disk stack, paring and discharge ring.

The bowl shell has eight equally spaced drain holes around the raised center of its bottom. These holes facilitate draining the bowl when the purifier is in its stopping cycle. The draining liquids are directed into the annular space between the bowl shell and the bowl casing and thence out the bowl casing drain line.

In order to insure that the drain holes will not become clogged by dirt from the bowl shell, a conical-shaped strainer is installed over the top of the drain holes.

The bowl shell seats on the tapered portion of the top of the spindle shaft. The threaded top


DISCHARGE RING
COUPLING NUT
PARING DISK
BOWL TOP
INTERMEDIATE TOP DISK
TOP DISK
COUPLING RING
O-RING
SPINDLE CAP NUT
INTERMEDIATE DISK
BOWL STRAINER
TUBULAR SHAFT
BOWL SPINDLE
BOWL SHELL

198.72

Figure 8-26.—Bowl assembly.

section of the spindle shaft protrudes up through the raised center of the bowl shell. A spindle capnut is then screwed down over the threads to force the bowl shell down onto the tapered portion of the spindle shaft.

A slot is provided on each side of the bowl shell on its outer surface near the top. These two slots engage the bowl shell lock screws during disassembly or assembly of the bowl shell. A notch at the upper/outside edge of the bowl shell engages the bowl top.

The tubular shaft is the base and the center of the disk stack. It forms a circular bulkhead between the feed inlet liquids and the disk-stack discharge to the paring disk.

The base of the tubular shaft has three unequally spaced pins which interlock with three unequally spaced slots around the raised center of the inside-bottom of the bowl shell. Thus, the tubular shaft can be installed in one position only, and insures that the tubular shaft will rotate.

The flared base of the tubular shaft is the bottom of the disk stack. A liquid passage, between the bowl shell and the underside of the tubular shaft's base, is provided by 12 inner spacers. The inner spacers are part of the tubular shaft, and serve two purposes—they keep the tubular shaft off the bowl shell to provide the liquid passage, and they give a circular motion to the feed inlet liquid, since they act as rotating paddles. The 12 inner spacers run from the top-inside area of the tubular shaft and follow its contour down and under the flared base to the outer edge of the base.

Twelve equally spaced holes are provided near the outer edge of the tubular shaft's flared base. These holes are located between the 12 inner spacers.

The outer edge of the tubular shaft above the flared base has 12 equally spaced outer spacers. These outer spacers perform the same function for the purified JP-5 that the previously mentioned inner spacers perform on the feed inlet liquids. One of the outer spacers has a key to which each of the disks in the disk stack locks. This insures that the disks will rotate.

The intermediate disks form the main part of the disk stack. There are 127 individual intermediate disks. Each has a number stamped on its top side near its outer edge. The disks are numbered 1 through 127; number 1 disk is on the bottom and number 127 is on the top.

The 127 intermediate disks are identical, except for their numbers. The following description applies to each intermediate disk. In shape, the disk resembles a metal lampshade, large at its base and small at the top. A small lip flares out from the base and a small lip flares inward from the top.

Twelve equally spaced holes are located around the base of the disk. A thin sliver of metal (0.026-inch thick) runs from between each hole inward to the inner lip. These pieces of metal, located on the top of each intermediate disk, act as spacers. Since the disks seat one on top of the other, the thickness of the space between each disk is determined by the thickness of the spacers.

The top inner lip of each intermediate disk has a notch which interlocks with the key on the tubular shaft. This interlocking insures that the disks rotate and, also, insures that the disk holes will be alined vertically.

An intermediate top disk seats on top of the topmost intermediate disk. This disk is similar in construction to the 127 intermediate disks except that its flared lip around its base is only half as large as the lip on the intermediate disks, and it does not have a stamped number.

The top disk seats on top of the intermediate top disk and is the top disk of the disk stack. Being wider than the other disks in the stack, the top disk covers the disk stack like an umbrella. This is the only disk that does not have holes around its base. The inner-upper portion of the top disk is the pump casing for the paring disk. The lower portion of the pump casing has a notch that interlocks with the key on the tubular shaft, thus insuring that the top disk will rotate.

Twelve outer spacers, equally spaced around the top side of the top disk, extend from beyond the rim of the base inward to the top of the pump casing. The outer end of each spacer extends below and partially up the underside of the top disk. These spacers perform the same function to separated water as the outer spacers on the tubular shaft perform on the purified JP-5.

A vane-type centripetal pump, the paring disk, is housed within the pump casing area of the top disk. The paring disk does not rotate; it is threaded into the regulating tube of the feed tube assembly (see "Cover Assembly"). In the case of this pump, the pump casing revolves around the impeller; thus, the flow is from the outside/in. This flow, being centripetal, is just the reverse of a centrifugal pump.

The feed tube of the cover's feed tube assembly is the pump shaft. A nylon protecting collar fits snugly around the top of the paring disk. When the feed tube is screwed into the paring disk, the paring disk is raised until the protecting collar contacts the upper/inside area of the pump casing. In this position, the protecting collar acts as a wearing ring for the paring disk.

A bowl top seats on the top of the top disk's spacers. Discharging water flows up through the space between the top disk and the bowl top. The conical-shaped bowl top is thicker at the bottom than at the top. Part of this thick base rests on top of the bowl shell and part of it extends down inside the bowl shell.

The part of the bowl top extending down inside the bowl shell has an O-ring retaining groove. An oil-resistant O-ring installed in this groove forms a liquid-tight seal between the bowl top and the bowl shell. This seal insures that the liquids involved in the purifying process will be confined to their normal flow through the bowl shell assembly.

A large coupling ring is threaded down over the base of the bowl top to the upper/outside edge of the bowl shell. This ring holds the bowl top in place.

A rectangular metal bar is bolted to the outer rim of the base on one side of the bowl top. This bar engages a notch in the bowl shell to insure rotation of the bowl top.

The top edge of the bowl top has a retaining groove into which is inserted an oil-resistant rubber seal ring. This particular ring is a flat rubber washer, not an O-ring. A discharge ring seats on top of this seal ring.

The outer edge around the top of the bowl top is threaded to receive a coupling nut. The coupling nut screws down over the discharge ring, forcing the discharge ring down onto the rubber seal ring. This sealing insures that discharging water will flow up through the center of the discharge ring.

The coupling ring, as previously stated, forces the bowl top down onto the top of the bowl shell, thus completing a seal. As the coupling ring is screwed downward, it forces the bowl top down onto the disk stack. This action compresses the disk stack and insures that each disk will seat tightly on its adjacent disks. The space between each disk is thereby assured to be correct.

To insure correct tension on the disk stack, an alining mark is stamped on the coupling ring and the bowl top. These two marks must be lined up when tightening the coupling ring. An indicating arrow and the word "OPEN" are also stamped on top of the coupling ring. These marks show the direction of rotation to remove the coupling ring.

CAUTION: The coupling ring has left-hand threads.

Four T-shaped slots are equally spaced around the outside/upper rim of the coupling ring. A special wrench engages all of these slots for removal or installation of the coupling ring.

A discharge ring, seated on top of the bowl top, acts as a dam to maintain the proper line of separation between the water and the JP-5 within the bowl shell assembly.

Each purifier is furnished with a set of seven discharge rings. The outside diameters of the discharge rings are the same. The inside diameters of the discharge rings are different. The inside diameter size is etched on each ring. The inside diameters range from 220 millimeters to 250 millimeters in 5-millimeter steps (220, 225, 230, 235, 240, 245, and 250).

The previously mentioned coupling nut locks the discharge ring in place. Like the coupling ring, the coupling nut also has an indicating arrow and the word "OPEN" stamped on its top.

The coupling nut has four circular slots equally spaced around its outer edge. A special wrench engages one of these slots for removal or installation.

PURIFIER OPERATIONS

The operations described in this section deal with starting from two different conditions–with a clean bowl and with a dirty bowl.

Regardless of the condition of the bowl, there are some preliminary steps to be taken every time prior to starting the purifier. These steps are:

1. Open the cover.
2. Make sure the handbrake is in the OFF position.
3. Remove the two bowl shell lock screws.
4. Insert the two bowl shell lock screw plugs.

5. Turn the bowl by hand. If the bowl does not turn freely, investigate and correct the cause.

6. Check the level of oil in the oil sump. If the oil is at or below the red line, add sufficient oil to raise the oil level to the white line.

7. Check the condition of the four clutch linings. If the center of any of these linings is less than 5/32-inch, replace all four linings.

8. Rotate the electric motor hub by hand in the reverse direction of normal rotation. If the clutch sleeve is cracked, the friction weights will catch on the cracks. Never run the purifier with a cracked sleeve.

9. Close the cover and engage the feed tube to the paring disk.

10. Engage and tighten the three handwheel cover clamps.

11. Connect the seal water inlet hose to the seal water inlet plug valve on the purifier.

The following starting and stopping procedures are for transferring fuel from one port wing stowage tank, through one transfer pump, through the port purifier, to one port wing service tank. Since transfer is from wing tank to wing tank within the same group of tanks, and on the same side of the ship, there is very little change to the list and trim of the ship. The starboard service tanks can be filled from starboard stowage tanks in the same manner. However, the transferring is accomplished by using only one transfer pump to pump into one purifier, since they both have the same capacity.

Starting with a clean bowl is accomplished as follows:

1. Close the following valves:
   a. Manifold telltale valves, as applicable.
   b. Sample connections.
   c. Purifier inlet globe valve.
   d. Purifier discharge globe valve.
   e. Purifier seal water inlet plug valve.

2. Open the following valves:
   a. Manifold tank side valve.
   b. Manifold transfer main side valve.
   c. Transfer pump inlet valve.
   d. Transfer pump discharge valve.
   e. Transfer pump inlet and discharge gage valve.
   f. Fresh water supply valve (seal water supply).
   g. Bowl casing drain valve (locked open).
   h. Service tank fill valve.
3. Start the purifier (press start button).
4. When the purifier bowl shell assembly attains 4,100 rpm (146 to 150 bumps per minute within 3 minutes), open the seal water inlet plug valve.
5. Open the main water-discharge observation port on the cover assembly.
6. When water discharges past the observation port, close the following valves:
   a. Seal water inlet plug valve.
   b. Fresh water supply valve.
7. Start the transfer pump (press start button).
8. Slowly open the following valves simultaneously:
   a. Purifier inlet globe valve and throttle to maintain 9 psi inlet pressure.
   b. Purifier discharge globe valve and throttle to maintain 30 psi back pressure.
9. Log the time the following were started:
   a. Transfer pump.
   b. Purifier.

10. While the purifier is running:
    a. Log the transfer pump inlet and discharge gage readings.
    b. Log the purifier inlet and discharge gage readings.
    c. Log the feed inlet temperature.
    d. Take inlet and discharge samples:
       (1) Analyze samples with the AEL contaminated Fuel Detector Mk III.
       (2) Log the results of the analysis.

11. When the transfer pump loses suction on the stowage tank:
    a. Close the purifier inlet and discharge globe valves.
    b. Open the manifold valves for the next stowage tank to be emptied.
    c. Close the manifold valves for the already empty stowage tank.

   d. Repeat step number 8.

12. When the service tanks is 95 percent full, stop the transfer operation. The procedure for stopping the purifier is as follows:
    a. Close the purifier inlet glove valve.
    b. Stop the transfer pump (press the stop button).
    c. Stop the purifier (press the stop button).
    d. Do not engage the brake.
    e. The purifier will coast to a stop (approximately 45 minutes).
    f. As the purifier slows down:
       (1) Centrifugal force diminishes.
       (2) Feed inlet pressure will drop to zero.
       (3) Discharge pressure will drop to zero.
    g. When the flapper in the discharge sight flow gage stops flapping, close the purifier discharge globe valve.
    h. Close all valves still open.
    i. Log the time the following were stopped:
       (1) Transfer pump.
       (2) Purifier.
    j. Log the gross gallons removed from the stowage tanks.
    k. Log the net gallons transferred into the service tank.

Emergency stopping procedures are: Press the purifier stop button, apply the hand brake (handle up), stop the transfer pump, close the purifier discharge and inlet globe valves.

NOTE: Since the purifier discharge and inlet valves are closed in that order, JP-5 trapped in the purifier places an added resistance to rotation, thus helping to stop the purifier.

The procedure for starting the purifier with a dirty bowl is as follows:

1. Complete all the preliminary steps.
2. Complete steps 1, 2, and 3 as when starting with a clean bowl.
3. Open the purifier seal water inlet plug valve.
4. When the purifier attains full rpm, complete steps 5 through 12.
5. To stop the purifier, proceed as previously described.

The position of the line of separation between the JP-5 and water is important to proper purification. For good purification, this line should be outside of the disk stack but well under the top disk. If the line of separation is too far out, some or all of the JP-5 will discharge with the water. If the line of separation is too far in, water will discharge with the JP-5. The position of the line of separation depends upon the selection of the proper discharge ring. The discharge ring depends on the specific gravity of the JP-5. Once the specific gravity is determined, refer to the chart of discharge ring sizes (fig. 8-27).

Find the specific gravity number along the base of the chart. From this point, inscribe a vertical line up the chart until it intersects with the solid curved reference line. From the point of intersection, inscribe a horizontal line to the left-hand border of the chart. The numbers along the left-hand border do not exactly point to a ring number; always use the next smaller ring.

Install this ring in the purifier. Operate the purifier, and observe the JP-5 and water-discharge sight flow gages.

If all of the discharge goes out the water discharge, the discharge ring is too large. Stop the purifier and install the next smaller ring.

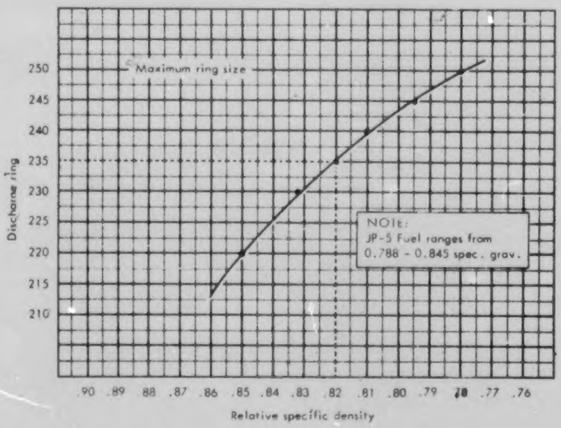


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Figure 8-27.—Discharge ring size chart.

Make another trial. If necessary, repeat until JP-5 is properly discharged from the bowl shell assembly. If more than one trial is required, it generally indicates a mistake was made in determining the correct specific gravity or in using the discharge ring size chart.

CAUTION: When the seal water is cold, a small amount of JP-5 may discharge with the water at first. This will cease as the water, JP-5, and purifier heat up. In this case, it will not be necessary to change the discharge ring.

If water discharges with the JP-5, the discharge ring is too small; try the next larger ring.

When the proper size discharge ring is established, do not change it. As a general rule, the most satisfactory purification occurs when the discharge ring is the largest size possible without causing loss of JP-5.

During normal operations, there should be no more than a small discharge from the water outlet. The bulk of the discharge should be out the purifier JP-5 outlet.

If it is found that there is a large discharge from the water outlet, it indicates excessive water in the feed, or the water seal has been lost. The operator should immediately determine whether the excessive discharge is water or JP-5.

If the excessive discharge is JP-5, the bowl has lost its seal, stop the flow of feed, reprime the bowl, and slowly resume the flow of feed.

If the seal is again lost, immediately stop the purifier and check the discharge ring size and the bowl shell assembly's two rubber seal rings. Correct the cause and resume operation.

If the excessive discharge is water, secure the operation and determine the source of the water. Sound the stowage tanks with water-detecting paste and restrip the stowage tanks as necessary.

NOTE: If the tanks have been properly settled and stripped, there should never be but a trace of water in the feed.

If water has been put into the service tanks, they must also be stripped, if no water is found in the stowage tanks, check the piping in the bilge, voids, etc., for leaks or other possible sources of water.

PURIFIER MAINTENANCE

Establish and maintain a regular cleaning schedule, depending on the following factors:

1. Accumulation of a large quantity of heavy solids in the bowl shell will cause the bowl to run rough. The bowl must be cleaned before the wet cake exceeds 30 pounds or 1½-inch thickness at its thickest point.
2. If the purifier is to be inactive for less than 12 hours, it must be flushed out with fresh water while it is still operating, by using the priming water.
3. If the purifier is to be inactive longer than 12 hours, it must be disassembled and thoroughly cleaned.
4. In any event, the bowl must be disassembled and thoroughly cleaned at least once a week.

The purifier bowl should be inspected for corrosive pitting. If pitting is found, the bowl should be cleaned thoroughly with a mild abrasive cleaner in combination with stainless steel sponges. If pitting continues, the bowl should be reconditioned at the earliest opportunity.

Where pitting has progressed to ¼-inch in depth, replace the bowl.

CAUTION: Continued use of deeply pitted bowls can be potentially hazardous.

When disassembling and assembling the bowl shell assembly for cleaning, it must be borne in mind that the component parts are heavy. For this reason, a chain hoise and trolley have been provided to lift the parts and transport them to a deep sink. Extreme caution must be exercised when raising, lowering, and transporting the parts. It is imperative that the chain hoist be centered directly over the center of the spindle before any part is raised or lowered.

To disassemble the purifier for cleaning, proceed as follows:

1. After stopping the bowl, remove the plugs and insert the lock screws. (See fig. 8-28.) The two lock screws (one on each side of the

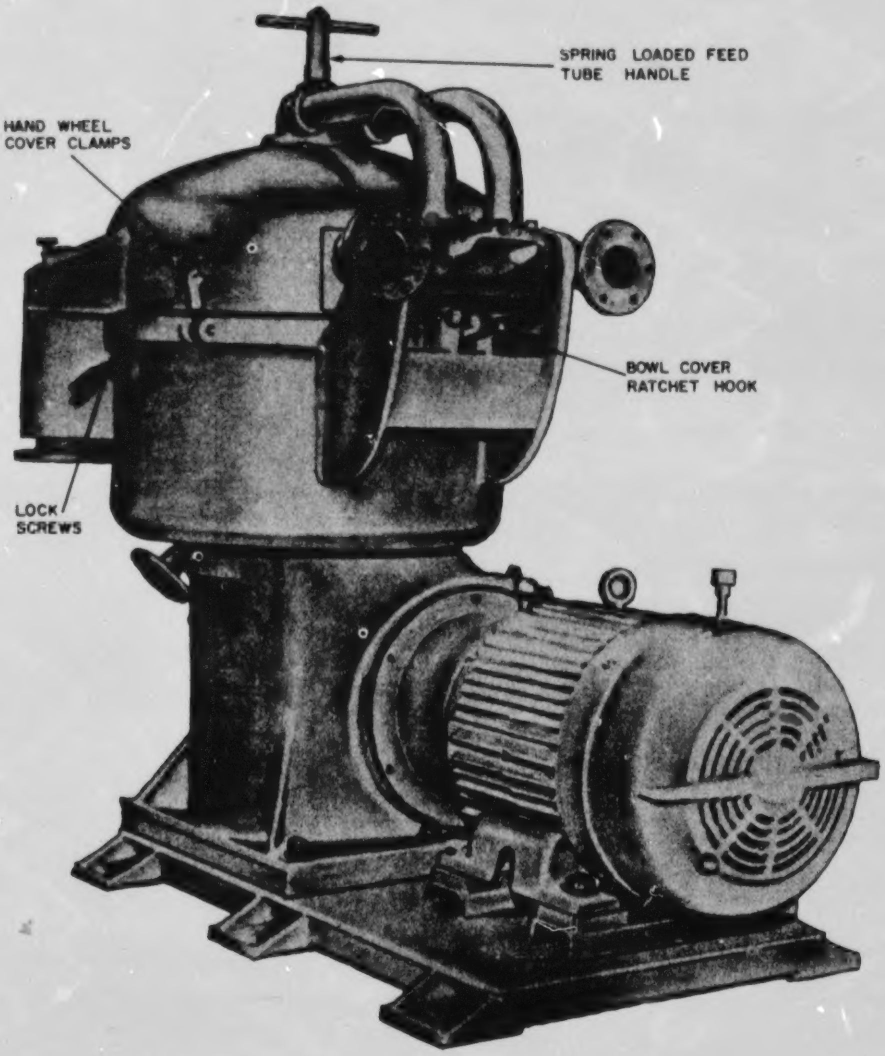
SPRING LOADED FEED TUBE HANDLE
HAND WHEEL COVER CLAMPS
BOWL COVER RATCHET HOOK
LOCK SCREWS

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Figure 8-28.—Rear view of purifier (cover closed).

purifier) enters the slots in the bowl shell, locking it in position.

2. Using the spring-loaded tee handle on top, unscrew the feed tube until it is free from the paring disk.

3. Loosen the three handwheel cover clamps and swing the bowl casing cover back until it engages the ratchet hook. This will automatically lock the cover in the open position.

4. Unscrew the bowl top coupling nut (fig. 8-29), using special tool (inset, fig. 8-29) and remove the discharge ring and rubber ring.

5. Remove the coupling ring (fig. 8-30) by loosening it first with the gear wrench, then

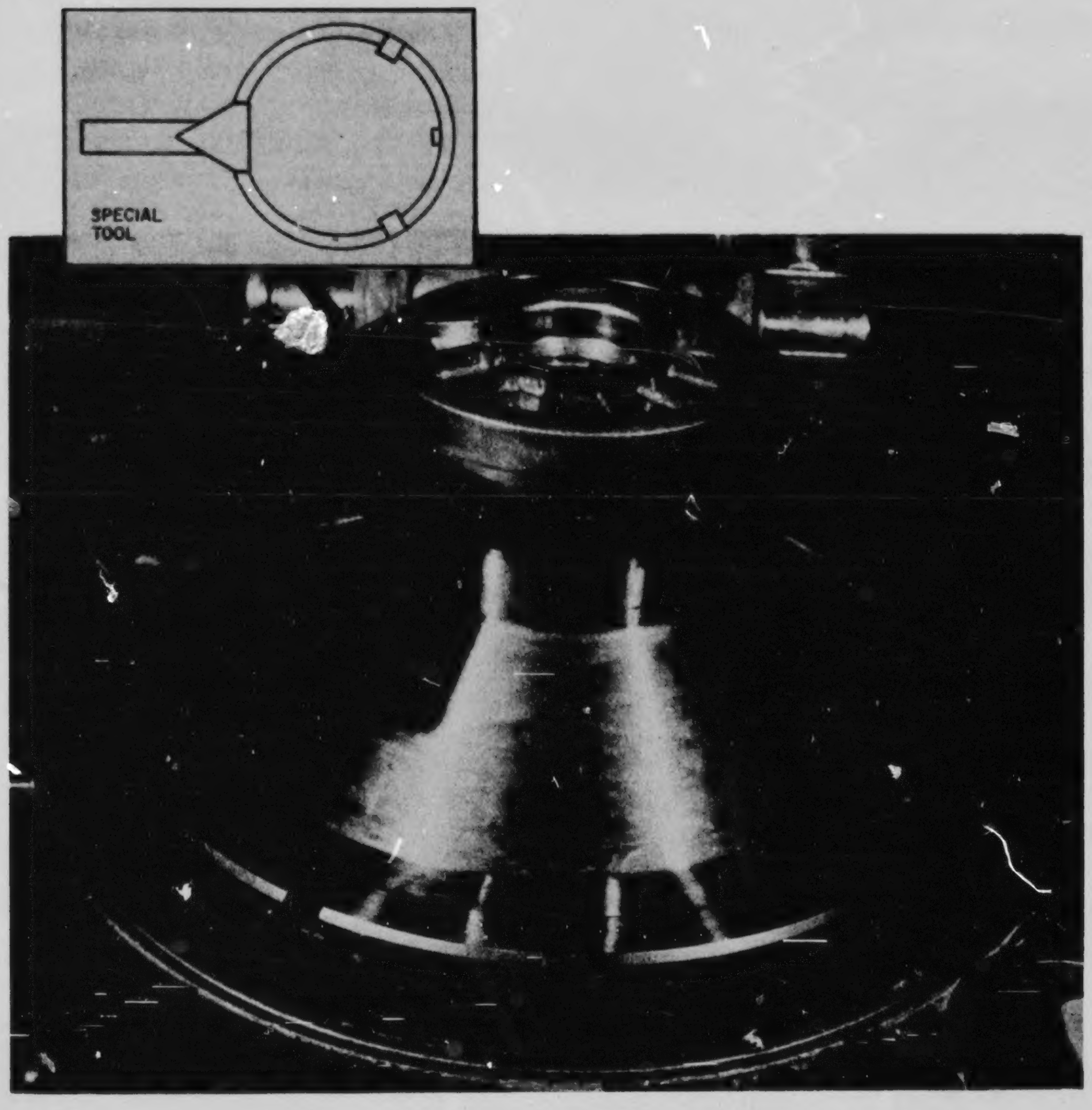

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Figure 8-29.—Removing bowl top coupling nut (with special tool).

unscrewing the coupling ring with the special tool.

6. After removing the coupling ring, screw the lifter into the bowl top. By turning in on the T-handle jackscrew on top of the lifter, the bowl top will let loose from the bowl shell. Using the chain hoist, lift the bowl top off, being careful with the rubber ring. Remove the rubber bowl ring and lay it flat.

7. Remove the tubular shaft, top disk, paring disk, and intermediate disks, with the

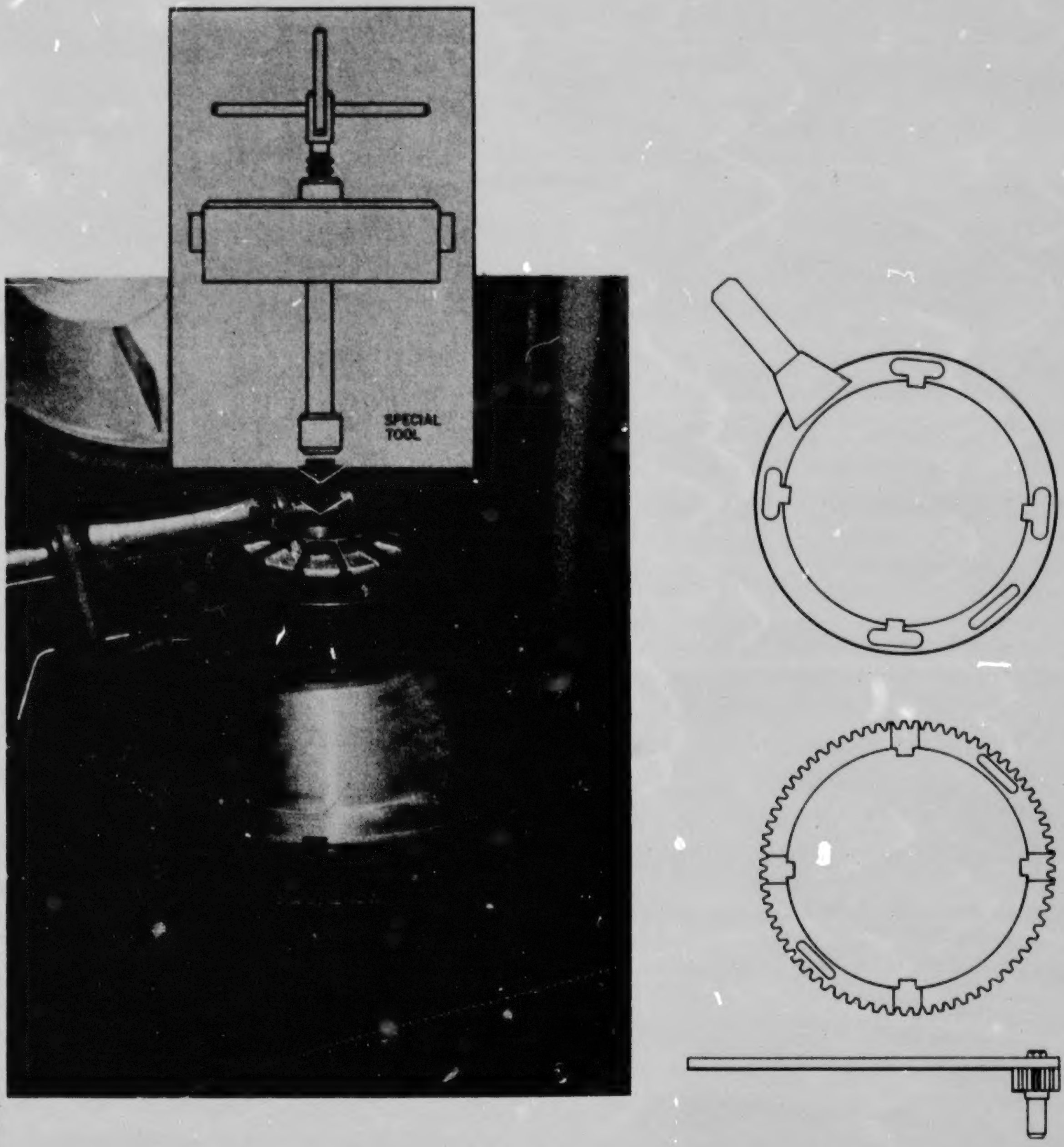
SPECIAL TOOL

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Figure 8-30.—Removing coupling ring (with special tools).

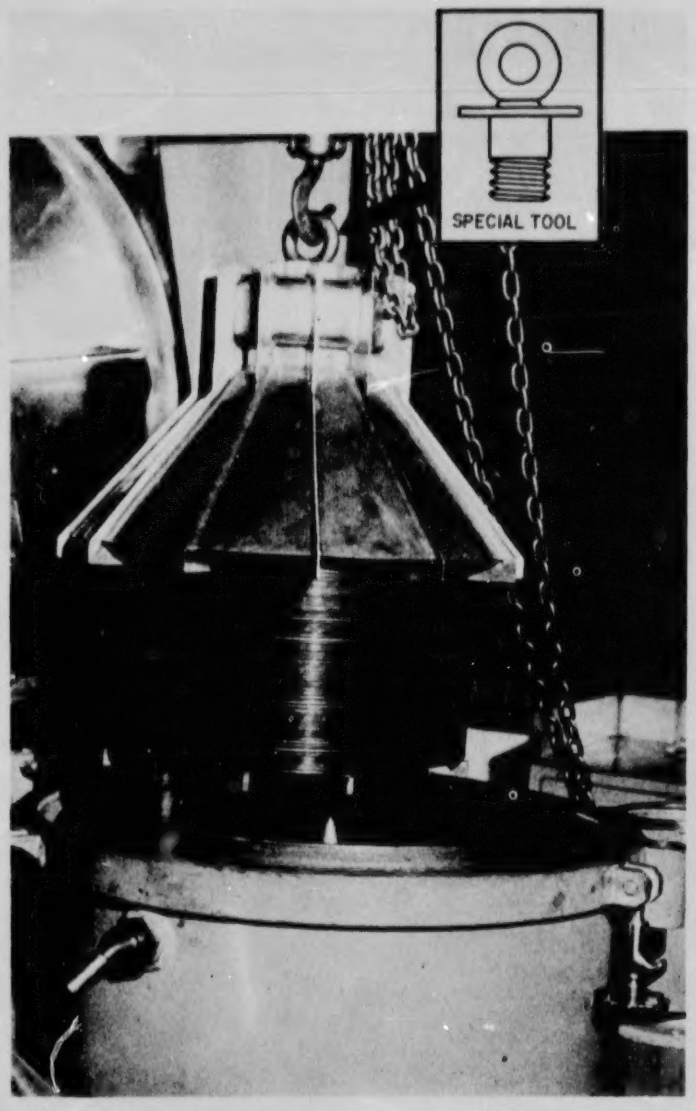

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Figure 8-31.—Removing disk stack.

chain hoist, using the special tool provided. (See fig. 8-31.)

8. To remove the bowl, lift out the bowl strainer. Remove the spindle cap nut and back out both lock screws. Screw the lifter (fig. 8-32) onto the bowl shell, and by turning in on the jackscrew the shell will loosen from the spindle. Using the chain hoist, lift the shell from the frame.

After the bowl parts have been disassembled, remove the rubber rings and clean the tubular shaft and disks with a brush using JP-5 as the cleaning fluid. Reassemble in the reverse order.

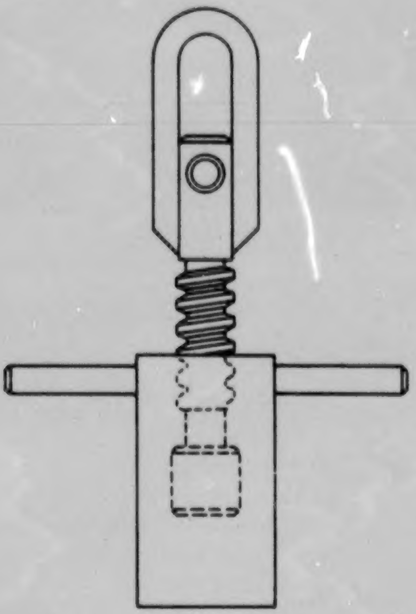

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Figure 8-32.–Bowl shell lifter.

O-rings and gaskets should never be hung vertically, lay them neatly on a clean, flat surface. Hanging will seriously distort the shape of O-rings and gaskets. When installing O-rings, always inspect them for nicks, cuts, or abrasions; use only good O-rings. Examine the O-ring retaining slots and other contact surfaces for nicks and burrs, and remove such before installing the ring. Make sure that the retaining slot and contact surface are clean, and coat the O-ring with a light machine oil before installation.

Maintain the lubrication system in a perfect condition. Refer to the manufacturer's instruction manual and current Instructions as to the type and amount of lubricant.

Clutch weights may occasionally crack and require replacement. Replacement weights are furnished in matched pairs and must be replaced in pairs to maintain balance. If, for example, No. 1 weight requires replacement, it will be necessary to replace the opposite weight (No. 3) also.

When a friction weight lining requires replacement, all four linings must be replaced.

The centrifugal clutch is the main source of trouble in the centrifugal purifier. In order to alleviate this situation, purifiers purchased after October 1961 do not have a centrifugal clutch. A direct-drive, explosion-proof, fan-cooled electric motor is utilized in lieu of a friction clutch or other friction type torque transmitting device.

The electrical controllers have an amber indicating "HOLD" light while the purifier is coming up to speed. It also has a green indicating "RUN" light when it is up to speed for loading purposes.

Yearly, the purifier should be completely disassembled and inspected, and any parts that are worn must be replaced.

CHAPTER 9

MAINTENANCE AND REPAIR

The ABF1 and ABFC must have the ability and knowledge to properly inspect the installation and to evaluate the operation of newly repaired or installed parts and components of the aviation fuels systems. He must be able to distinguish between a repairable part and one that is not. He must know the procedures required to make the fueling system safe for repair. His knowledge of the fuel system must be such that he can supervise and direct the repair of all components of the fuel system.

When the repair of a specific component of the fuel system is required, consult the technical manual for the proper clearances, tolerances, and order of removal and installation of the parts. The clearances and tolerances should never be a matter of guess or chance.

When similar components are being repaired or overhauled, the parts should be tagged and/or marked as to the component to which it belongs.

Since the introduction of the Navy Standard Maintenance and Material Management (3-M) System to the aviation fuels system and components, maintenance is coordinated with the use of Maintenance Index Pages and Maintenance Requirements Cards. The maintenance of the aviation fuels system remains under the cognizance of the aviation fuels repair team (formerly Repair 7).

AVIATION FUELS REPAIR TEAM

The aviation fuels repair shop is that space set aside aboard aircraft carriers for the stowage of damage control and maintenance equipment for the purpose of repairing the aviation fuels systems.

ORGANIZATION

The air officer is responsible for the organization of the aviation fuels repair team in accordance with the ship's battle bill. The repair team must be capable of handling all damage and casualties that occur within its assigned area.

Personnel assigned to the repair team must have a thorough knowledge of the aviation fuels stowage and distribution systems, the operation of assigned damage control equipment, and applicable damage control procedures. They must also be familiar with the properties and hazards of aviation fuel and all applicable safety precautions.

The personnel assigned to the repair team should be rotated on a regular basis to allow as many men as possible to acquire the necessary maintenance skills. This cross training will not only benefit the division, it aids the individual in preparing for advancement.

The major duties of this repair team are:

1. Locate and isolate damage to the aviation fuels stowage and distribution systems.
2. Clear spaces of aviation fuel and fuel vapor by approved methods.
3. Make tests to determine the presence or absence of explosive vapors and oxygen.
4. Make emergency repairs to the aviation fuels system.
5. Operate and maintain equipment necessary for the above functions.

Flight Quarters

During normal working hours and flight quarters, the repair team locker serves as the maintenance shop for the fuels systems. It is normally manned by a petty officer in charge, a phone talker, and various repairmen.

The repair team petty officer supervises the maintenance of the aviation fuels systems. Specific duties and responsibilities include:

1. Maintain a master maintenance log of the aviation fuels systems.
2. Insure the proper handling of inventory and stowage of tools, equipment, and spare parts under custody of the V-4 division.
3. Supervise the upkeep and cleanliness of repair team assigned spaces.
4. Insure that all men assigned are thoroughly instructed in their duties.
5. Insure that all safety, testing, and emergency equipment is in proper working condition.
6. Insure that all safety precautions are observed.
7. Conduct and assist in maintenance and repair of all aviation fueling equipment.
8. Maintain a log of all temporary issues of tools and equipment.
9. Conduct periodic checks on assigned sound powered phones.

General Quarters

During general quarters, the repair team becomes part of the damage control organization. The damage control organization is necessarily an integral part of the engineering department organization. An engineering department officer, known as the damage control assistant, is charged with the overall coordination of all damage control matters.

The aviation fuels officer is in charge of the aviation fuels repair team with the senior petty officer from the V-4 division as his assistant. The men that are normally assigned for maintenance in the division make up the repair team personnel. Other personnel assigned to this repair team include men in the HM, DC, and EM or IC ratings. Men from the repair team may also be assigned to other repair parties, such as Repair 1, or may form subdivisions of the fuels repair team at other locations in the ship.

The men assigned to the fuels repair team from the V-4 division should be trained and drilled in the following:

1. Methods of investigating and reporting damage.
2. Controlling and extinguishing fires.
3. Isolating damage to piping systems.
4. Restoring service to piping systems.
5. Rescuing personnel and caring for wounded.
6. Operating all types of damage control equipment.
7. Correct setting of material conditions of readiness.

PORTABLE EQUIPMENT

All portable equipment used in the maintenance and testing of the aviation fuels system is normally stored in fuels repair team locker. The checking and repair of this equipment is also carried out there. The ABF1 and ABFC are required to perform some of the maintenance of this equipment and to analyze any malfunction of this equipment. Major repair of this equipment is carried out by repair activities ashore. The operational procedures for this equipment can be found in ABF 3 and 2.

FLAME SAFETY LAMP

The flame safety lamp is used to determine the presence or absence of sufficient oxygen to support life. This device should be used only to test a space after the combustible gas indicator (explosimeter) has given a negative indication of the presence of flammable gasses. It should NEVER be used in a space suspected of containing free hydrogen or acetylene.

Prior to use of the flame safety lamp, inspect the following components:

1. Air admission ring.
2. Inner and outer gauze cones.
3. All gaskets.
4. Glass shield.

These items must be clean and free of damage in order to confine the flame within the lamp. Clean or replace any items that fail the inspection.

PORTABLE INERTNESS ANALYZER

The dual service portable inertness analyzer is a battery-powered, electric instrument used to measure the percent inertness of a space charged with inert gas. Percent inertness is the percent reduction of oxygen in the space. For example, 60 percent inertness indicates that the air in the space contains about 8 percent oxygen.

The analyzer may also be used to indicate the presence of hydrocarbon vapor in the space. However, it will not indicate the amount or percentage.

The maintenance procedures for this instrument consist primarily of attention to the battery and chemicals. Repair of this instrument is normally accomplished by repair activities ashore.

Prior to use of the portable inertness analyzer, perform the following:

1. Turn current switch to "C" position.
2. Turn rheostat "C" to set needle at 100 on the scale.
3. Turn current switch to the "A" position.
4. Open petcock at bottom of moisture absorber (black cylinder).
5. Attach actuating pump discharge hose to moisture absorber petcock.
6. Work pump by hand in fresh air for about one minute.
7. Turn rheostat "A" to set indicator pointer at zero.
8. Turn current regulating rheostat off. If the indicating needle does not rest at zero, turn adjusting screw located in the panel under the dial.

When the current adjusting rheostat does not adjust the indicating needle to 100 on the dial, replace the battery.

After 50 analyses, check the calcium chloride. If it appears glazed or hard, replace it along with the cotton pad. At the same time inspect the activated carbon, it must be either replaced or reactivated. Normally it will be replaced unless a new supply of carbon is not available.

After each analysis, close the petcock to the black cylinder to preserve the life of the calcium chloride. For the protection of the instrument, always store it in the instrument box provided.

COMBUSTIBLE GAS INDICATOR

The combustible gas indicator may also be known as a hydrocarbon vapor indicator or an explosimeter. This is a battery-powered, electric instrument used to detect flammable and explosive mixtures of hydrocarbon vapors and air in an enclosed space. This type of indicator is the only convenient, reliable, and accurate means of determining the presence of these mixtures in varying concentrations. For this reason, it should be in frequent use in determining possible leakage of gasoline or gasoline vapor.

The graduations of the indicating meter are in percent of the lower explosive limit. This scale ranges from 0 to 100.

EXAMPLE: The lower explosive limit of gasoline is 1.4% by volume, which would read 100% on the indicating meter.

A reading above 60 indicates the gas concentration is near the explosive range and is unsafe for men to enter. Prior to operation, check sampling line connections for leaks; any leakage would result in a faulty reading. Inspect flash back arresters; if they are clogged, replace with new arresters. Inspect the condition of the filter. Inspect the flow regulating orifice, this orifice is located in the aspirator bulb coupling.

Toggle switches are located on either side of the indicator dial. The right-hand switch is marked ON-OFF. This is a connecting switch between the battery supply and the testing circuit. When operating the instrument, turn this switch ON.

The left-hand switch is marked CHECK-READ. In the CHECK position, the dial indicates whether sufficient current is being supplied from the batteries. The pointer should rest on a green arrow in the center of the dial. If it does not, the electrical supply may be adjusted by turning the knob marked VOLT ADJ, which is located on the right-hand side of the indicator.

In the READ position, the dial pointer should fall to zero. This may be adjusted by turning the knob marked ZERO ADJ. This knob is located on the left-hand side of the dial.

When the pointer remains below zero, and cannot be adjusted, the batteries need replacing. Replace all batteries at the same time. If the pointer moves to the extreme right of the scale, with explosimeter on, and cannot be adjusted to zero, the detector's filament is burned out and must be replaced.

PORTABLE BLOWERS

Portable blowers of the air-turbine-driven and the electrical motor type require very little maintenance other than lubrication and proper stowage. Moisture in the compressed air used to drive the air turbine sometimes freezes in the turbine outlet. This will prevent the blower from operating efficiently.

The electrical blower should never be used to vent a compartment that contains explosive hydrocarbon vapors. The air-turbine blower should always be used for this purpose. The discharge hose from this blower should always be directed outside the shell of the ship.

NONSPARKING TOOLS

These tools are made of several materials—brass, beryllium alloy, and aluminum. The brass used for socket sets, pliers, and wrenches are the least costly. However, they do not have the strength of steel tools and are easily broken. Beryllium alloy tools are very expensive, but are closer in strength to steel. Aluminum is used to make large pipe wrenches. They do not have the strength of steel wrenches but are very light and easily handled. All tools should be cleaned after use and stowed so that they are ccessible.

HOSE (AIR LINE) MASK

Hose or air line masks are furnished to all hips which have repair party lockers. This type of mask can be used to protect personnel ntering voids or other spaces which contain oxic gases or which are deficient in oxygen. The ir line mask is particularly useful for entering spaces which have extremely small access openings, where the more bulky oxygen breathing apparatus would be hard to use. Figure 9-1 shows the regular issue air line mask.

These masks are designed to be used with compressed air stowed in cylinders at a pressure of 1,800 psi. If the pressure in the cylinders drops below 1,700 psi when not in use, recharge the cylinders. Each unit consists of two compressed air cylinders, which are manifolded to an individual compressed air regulator which reduces the air from cylinder pressure to a pressure and delivery rate suitable for breathing. The regulator is equipped with two pressure gages, one to indicate cylinder pressure and the other to indicate delivery pressure from the regulator.

Air line masks similar to those issued can be made up on board ship when necessary from ND Mark III or ND Mark IV gas masks. (See fig. 9-2.) An air line mask constructed from gas mask parts uses a T connection for the breathing tubes rather than the Y connection used on the regular issue air line masks.

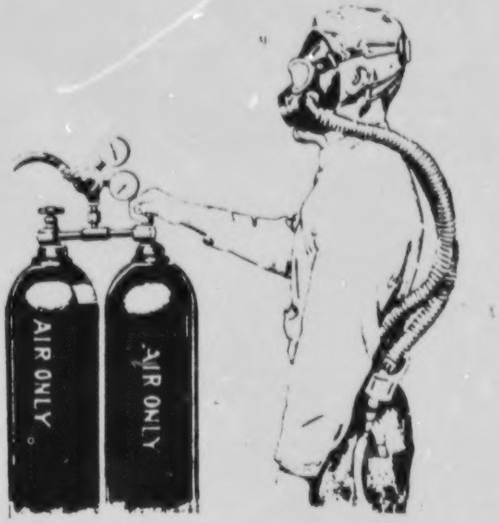

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Figure 9-1.—Air line mask, regular issue.

CAUTION: Air line masks are designed for use with compressed air, not with oxygen. NEVER use oxygen with an air line mask.

Lifeline

Personnel wearing an air line hose mask when entering aviation gasoline stowage tanks, voids, etc., which contain toxic gases, must be equipped with a lifeline, and tended by a reliable man outside the space.

The Navy Standard Lifeline is a 50-foot steel-wire cable fitted with snaphooks on each end. The lifeline should be attached to the upper part of the body, preferably to the backloop of a shoulder harness. A cardinal rule is—NEVER attach a lifeline to the waist.

When the lifeline is used, it is essential that the wearer and tender be able to communicate with each other. Standard diver's signals are normally used for this purpose; however, only the basic signals are needed for tank cleaners. These signals, with meanings modified to fit the tank cleaner situation, are as follows:

TENDER TO WEARER

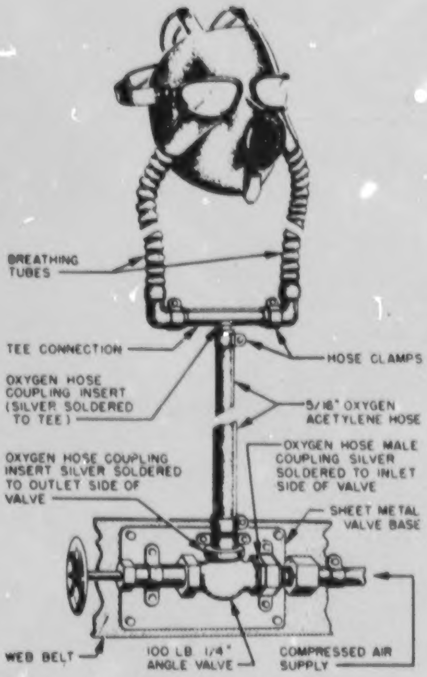
Pulls on line	Meaning
1.	Are you all right?
2.	Advance.
3.	Back out.
4.	Come out immediately.

WEARER TO TENDER

Pulls on line	Meaning
1.	I am all right.
2.	I am going ahead.
3.	Keep slack out of line.
4.	Send help.

An easy way to remember the signals is:

CODE	PULL	MEANING
O	1	OK.
A	2	Advance.
T	3	Take up.
H	4	Help.


BREATHING TUBES
TEE CONNECTION
HOSE CLAMPS
OXYGEN HOSE COUPLING INSERT (SILVER SOLDERED TO TEE)
5/16" OXYGEN ACETYLENE HOSE
OXYGEN HOSE MALE COUPLING SILVER SOLDERED TO INLET SIDE OF VALVE
OXYGEN HOSE COUPLING INSERT SILVER SOLDERED TO OUTLET SIDE OF VALVE
SHEET METAL VALVE BASE
WEB BELT
100 LB 1/4" ANGLE VALVE
COMPRESSED AIR SUPPLY

198.79

Figure 9-2.—Air line mask constructed from gas mask.

PORTABLE AIR-OPERATED DEFUELING PUMP

The defueling unit made by the B. P. Elkin Co. uses a Wayne all-bronze, two-tooth difference, internal gear type pump driven by a Boston Pneumatic Air Motor. This unit without the required hose weighs approximately 80 pounds. The pump is rated at 28 gpm at a 25 psi total head with a suction of 3 inches Hg.

The air motor unit consists of a conventional four-blade rotary air motor and a two-step gear reduction. All rotating parts are mounted on ball bearings. A weight type centrifugal governor prevents overspeeding by restricting the volume of air admitted to the motor when the motor speed reaches a predetermined maximum. A ½-inch cock for manually controlling the power and speed of the motor is mounted on the unit.

The air motor is constructed of precision-built parts which must operate at very close clearances and in perfect alinement. Reasonable care must be taken to prevent damage to these parts. Distortion, burring, or scoring of parts will seriously affect motor performances.

Loss of power, erratic action, or motor failure may be caused by factors outside the air motor. Check for:

1. Low air pressure. Air pressure at the motor, with motor running wide open, should be from 70 to 110 psi, preferably 90 psi. Low air pressure is frequently caused by use of hose of insufficient size. Use ½-inch hose for lengths up to 50 feet. Use ¾-inch hose for any length over 50 feet.
2. Wet or dirty air. Water or dirt (scale, particles of rotten hose, etc.) in the air line will seriously affect performance and may cause damage to the motor.

If the foregoing are found to be in order, check, in sequence, the following:

1. Motor lubrication. Remove the airhose and pour a small quantity of recommended oil in the air inlet of the throttle valve. Fill the oil reservoir on top of the head casting.
2. Rotovane motor. Remove and disassemble the rotovane motor. Thoroughly clean all parts in JP-5 or type II solvent (Federal Specification P-S-661). Repair or replace parts that are badly worn or broken. (Give particular attention to rotovanes, as they are subject to considerable wear.) Repack bearings with grease, lightly coat all other parts with oil, and reassemble.
3. Gearing. Remove the rotovane housing from the quill housing and disassemble the quill housing. Thoroughly clean all parts and remove all old grease from the quill housing. Check all parts and repair, or renew those badly worn or damaged.

The lubrication of the defueling unit is as follows:

1. Before connecting the airhose, always pour a small quantity of oil into the air inlet of the valve.
2. After each 8 hours of operation, remove the oil plug located in the top head casting and refill the oil reservoir; then replace the plug.
3. After each 100 hours of service, add three or four gun shots of recommended grease to the two grease plugs, one located in the rotovane motor housing, and the other located in the top head casting.

EMERGENCY REPAIRS

A leak of any size in an aviation fuels system may create an emergency situation. Most leaks occur at flange joints due to leaking gaskets, or at pump and valve packing. These types of leaks can be prevented or minimized by proper maintenance and frequent inspection. Due to the many types of fuels systems there is no way to state which valves are to be closed or opened to isolate or bypass a given section of a system.

ISOLATING DAMAGED SECTIONS

An ABF assigned to a repair team must know the location and function of each valve in the system. The only way that this can be done is by study of the system, piping schematics, and blueprints related to the system.

The ABF must also know the methods of restoring the installed ventilation for the below deck spaces and the ways and means of rigging portable ventilation blowers and hoses.

Ruptures and breaks in fuel piping may happen at any time and for many reasons. The fuels system may be inerted or in operation.

If, for any reason, an aviation fuels line inside the ship is ruptured when it is pressurized with fuel, the following procedure should be followed:

1. Immediately stop all pumps servicing the affected piping.
2. Isolate the affected piping by manipulating the appropriate valves.
3. Remove all unauthorized personnel and personnel not wearing appropriate breathing apparatus from the space.
4. Stop all electrical machinery (except explosionproof motors) both in the space and in adjacent spaces through which air currents might

pass from the space containing explosive vapor. CAUTION: Operate remote switches to prevent the possibility of sparks. Take all possible precautions to prevent sparks from electrical or mechanical means.

5. Close and, if necessary, seal the space until effective exhaust ventilation is assured.

6. Drain and purge the affected piping until required repairs can be made.

If a fuel line outside the ship is ruptured when pressurized with fuel, the procedure is essentially the same; however, the danger of explosive vapors is greatly minimized. The fuel vapors should be carried away before a dangerous mixture forms; however, extreme caution must be exercised in the immediate vicinity of the rupture.

If an enemy attack is imminent, all aviation fuel should be drained from the fuel lines into the stowage tanks. All lines are then purged and charged with an inert gas. This prevents the formation of explosive vapors from entering the ship in the event fuel lines are ruptured.

If a fuel line that is charged with an inert gas is ruptured, it can be repaired with a soft patch and then recharged. Before entering spaces in the vicinity of such ruptures, a test must be made with the combustible gas indicator to determine the absence/presence of flammable gases. If flammable gases are present, the spaces are ventilated free of them and again retested with the combustible gas indicator before entering. Since the spaces may contain inert gas, the flame safety lamp is also used before entering to insure the presence of adequate oxygen to support life.

PIPE PATCHING

Repairs to piping are classified as permanent or temporary. The type of repair to be made at any time depends upon the circumstances. Permanent repairs are made when the same material as the ruptured piping is available and the system is secured for the time required to make the repair. Temporary repairs are made when the original material is not available or the system cannot be secured.

Temporary Repairs

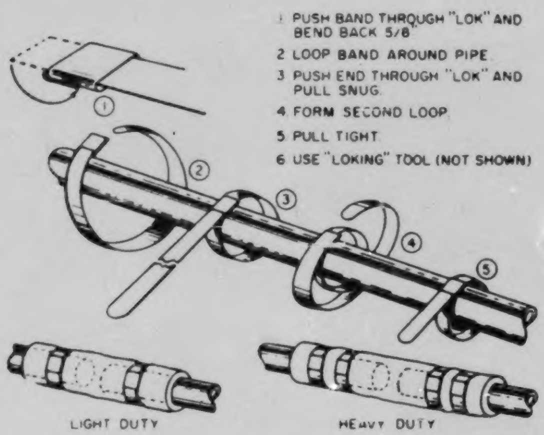
Temporary repairs are usually made by securing some type of patch over the leaking section of pipe. The material used for the patch depends upon the type of piping that is being repaired.

All water and aviation fuel lines can be easily repaired and service restored to the system in as little time as 30 minutes by use of Emergency Damage Control Metallic Pipe Repair Kit. This is a plastic patch kit. Materials used include–void cover (fibrous glass cloth with cured resin surface), resin and activator, fibrous glass tape, and fibrous glass mat. These materials are easily workable before hardening, as tape and putty can be applied by relatively untrained personnel. Pressure of 300 psi can be handled consistently. Application is flexible and provides a quick emergency method of repairing a wide variety of damage to pipes, flanges, elbows, and connections of various sizes. Completely severed ends of pipe can be joined. Odd shapes and jagged protrusions are no obstacles. Application of these patches are limited only by working space available and the ingenuity of personnel involved. Time required to apply patches is dependent upon the shape to be repaired, the working space available, and curing time. Patches can be applied to straight pipes and elbows in minutes. Pressure may be applied about 20 minutes after repairs are completed. Complete application instructions are included in each kit.

For low-pressure sea water piping, red lead putty wrapped about with canvas and served with marlin or electric friction tape makes an excellent, easily applied patch. A small leak in this kind of piping often can be stopped by driving in a soft pine plug. The moisture will cause the wood to swell and remain in place.

Patches may also be made from portland cement, cast in place and secured by metal bands. On low-pressure water piping, cast a portland cement collar entirely around the line. Iron cement can be used effectively to make emergency patches on iron or steel low pressure piping.

Banding toolkits are available in repair lockers. These kits may be used in the manner shown in figure 9-3 for the emergency banding


1 PUSH BAND THROUGH "LOK" AND BEND BACK 5/8"
2 LOOP BAND AROUND PIPE
3 PUSH END THROUGH "LOK" AND PULL SNUG
4 FORM SECOND LOOP
5 PULL TIGHT
6 USE "LOKING" TOOL (NOT SHOWN)
①
②
③
④
⑤
LIGHT DUTY
HEAVY DUTY

197.64

Figure 9-3.—Pipe banding.

of pipe patches. The banding material is available in various widths. A manufacturer's technical manual is furnished with each banding toolkit. The ABF should study the technical manual and also have actual practice in the use of banding equipment before attempting to use it in an emergency situation.

In all cases where temporary repairs to piping are necessary, the head of the department concerned must determine that the repairs are such that the safety of personnel is not impaired.

Permanent Repair

A repair is considered permanent if it restores the piping system to its original serviceability and if it can be expected to last for the life of the system. All temporary repairs to piping should be replaced with permanent repairs as soon as practicable.

Permanent repairs may be made in various ways, depending upon the nature of the damage, the operating conditions of the system, and the material of which the system is made. Probably the most common type of permanent repair is the complete replacement of an assembly or subassembly. However, damage that is not serious enough to require the replacement of an entire section can often be repaired permanently by other means, such as patching, tightening joints, and repacking valves.

Permanent repair work requiring burning and welding is accomplished by the ship's engineering department or at a shipyard. However, V-4 division personnel may be called on to assist.

MAINTENANCE OF PIPING SYSTEMS

Early detection and correction of piping defects are of utmost importance, since the operational reliability of ships requires that all piping systems be in satisfactory operating condition. Damage to piping systems may result from battle or accident, or merely from the wear and tear of daily use. The ABF should know how to locate piping system troubles and how to make adequate repairs, when required. The technical know-how involved in performing practical damage control jobs, such as repairing joints and replacing a valve stem is covered here.

JOINTS

At regular intervals, the joints in piping systems should be inspected for leakage. A small amount of seepage at a joint may not seem important; but, if the trouble is not corrected, the leakage is likely to become greater and may create hazardous conditions.

Most joint leakage in piping systems is caused by misalinement or by failure to allow for expansion. Either of these troubles tends to throw excessive strains on the joints. When joints do not line up, the piping must be alined so that the flanges or unions meet properly without forcing, and the flange bolt studs can be inserted freely, without forcing either the piping or the studs.

An ABF1 or ABFC should know how to correct leakage at both threaded and flanged joints which are generally found aboard ship.

Leakage at Threaded Joints

Threaded connections have been used in piping systems to a considerable extent. Experience gained during World War II, and in various operating tests, revealed that these connections are susceptible to shock damage and tend to become loose as a result of vibration. Because of these test results, the general use of threaded connections is not permitted in critical piping systems on ships built to Navy specifications. However, some threaded connections that have been designed to eliminate the undesirable effect of threads (unions and union-end valves, and flareless fittings) are used.

Leakage at the threaded joints may often be corrected merely by tightening the connection. If tightening does not stop the leak, the joint must be taken down and the parts inspected for defects. If inspection reveals faulty threads, install a new section. If the threads are in good condition, the repair may consist of thoroughly cleaning the disassembled parts, recoating them with a suitable antifriction sealing compound, and carefully reassembling the joint. It should be noted that vibration of the piping system often causes screwed joints to work loose; if this occurs, correct the conditions which cause the vibration. As a rule, rearranging the hangers or providing additional hangers will eliminate the vibration.

Leakage at Flanged Joints

Leakage at the flanged joints may often be corrected by setting up on the flange bolts. If tightening does not stop the leakage, disassemble the joint. In some joints, renewing the gasket will stop the leakage; in other joints it will be necessary to resurface, reface, or renew the flanges. In this event assistance will be required from the engineering department.

When renewing a gasket, be sure to use the material appropriate for the pressures and type of liquid being used in the system.

Buna-N-Cork gasket material is used throughout the JP-5 and AvGas piping system, except where asbestos is specifically indicated in pumps. Asbestos material is used exclusively in sea water piping joints of the high-capacity aviation gasoline system.

Before renewing a gasket, clean the flange faces carefully, removing all traces of scale, grease, and other foreign matter. If the flange faces are eroded or uneven, reface them before making up the joint.

Most flanged joints require full-face gaskets—that is, gaskets in which the outside diameter of the gasket is equal to the greatest flange diameter. To mark gasket material for cutting a full-face gasket, lay the sheet packing over the flange, if practicable, and then mark the location of the boltholes and the inner and outer cutting limits by lightly tapping these areas with a ballpeen hammer. Then punch the boltholes, allowing sufficient clearance for the flange bolts, and trim the inner and outer edges of the gasket. See that the hole in the gasket is ¼ inch larger than the inside diameter of the pipe at the flange surface. In general, the thinner the gasket material for flexible gaskets, the better the joint; this is especially true for high-pressure joints. If the flanges are separated to the extent that it would require a thicker gasket than is normally used (1/16 inch), it is safer in a high-pressure joint to make a suitable distance piece (spacer) and use one thin gasket on each end rather than using one gasket thicker than 1/16 inch. On joints which require frequent breaking, one side of the gasket should be coated with graphite to lessen the danger of tearing the gasket when the joint is broken.

Ring gaskets, rather than full-face gaskets, are used in joints where the flanges are of the raised-face type.

The proper sequence for setting up the flange bolts is shown in figure 9-4. Using the proper sequence, set up each bolt sufficiently to seat the gasket. After the bolts have been set up evenly, tighten the bolts again until the proper clearance is obtained. Use a torque wrench when tightening the flange bolts to insure equal tension on each bolt.

Most piping system repairs involve breaking joints in the piping system. Before breaking joints in any shipboard piping system, be sure the following precautions are observed:

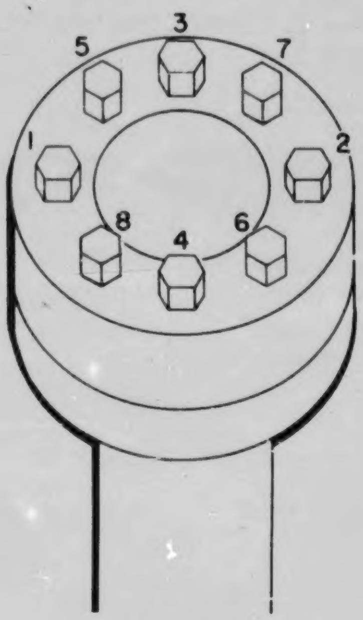


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Figure 9-4.—Typical bolting sequence.

1. Be sure there is no pressure on the line. This is important in practically all systems, but it is of vital importance in steam lines, full lines, hot water lines, and any sea water lines that may have a direct connection with the sea. It is not enough to merely close the valves; the valves must be locked or wired shut and must be tagged so that they will not be opened accidentally.
2. Be sure that the line is completely drained.
3. Leave two diametrically opposite securing nuts in place while loosening other nuts of the flanged joint; then slack off on the last two nuts. Insure that the line is clear, remove the nuts, and break the joint.
4. Take all appropriate precautions to prevent fire and explosion when cutting into lines or breaking joints in systems that have contained flammable fluids.
5. Observe all safety precautions required in connection with welding, brazing, or other processes used in repairing the piping.

FLANGE SAFETY SHIELDS

All JP-5 piping and valve flange joints located in heat producing areas such as firerooms, boilerrooms, etc., must be equipped with flange safety shields. (See fig. 9-5.)

In the event of a blown gasket or ruptured flange, when the system is pressurized, the safety shields restrict the JP-5 within the immediate area of the bilge.

A fatal engineroom fire was caused by JP-5 spraying from a blown flange gasket which initiated the installation of this shield.

Pipe flange safety shields, which act as leakage interceptors, are constructed of 24-gage galvanized sheet metal and designed to wrap around a pipe flange fitting. Each unit has an extended flap at one end with keyhole slots that button into two receiving screws. The body of the shield is formed to the shape of a channel with closely spaced overlapping segments as legs and spacing rods anchored between them to hold the shield equidistant at all points from the periphery of the pipe flange.

A galvanized steel wire cloth liner, no coarser than 14 x 16 mesh with 0.011-inch wire, is affixed to the inside of the shield between the spacing rods and the inside shield surface for the purpose of reducing the lateral aerosol mist.

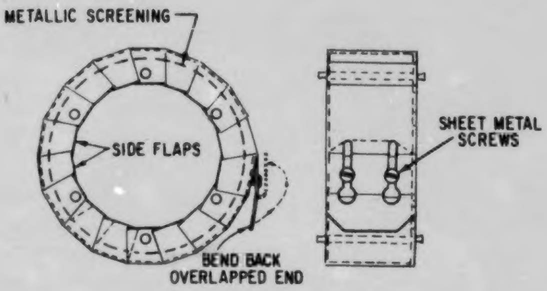

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Figure 9-5.—Typical flange safety shield.

VALVE MAINTENANCE AND REPAIRS

All valves require proper care and maintenance, just as do larger units of equipment, if they are to be kept in optimum working order. The principal difficulties encountered with valves are leakages past the seat and disk, leakages at the stuffing box, sticking valve stems, and loose valve disks. The ABF should know how to prevent and correct these faults.

Valve Leakage Causes and Remedies

Valve leakages, generally caused by failure of the disk and the seat to make close contact, may result from the following:

Foreign substances, such as scale, dirt, waste, or heavy grease lodged on the seat of the valve, may prevent the disk from being properly seated. If the obstructing material cannot be blown through, the valve has to be opened and cleaned.

Scoring of the valve seat or disk, which may be caused by erosion or by attempts to close the valve on dirt or scale, results in leaks. If the damage is slight, the valve may be made tight by grinding. If the damage is more extensive, the valve must be reseated and then ground.

A warped disk may result if the guides fit too tightly, if the spindle guide is bent, or if the valve stem is bent. Warping of the disk causes a valve to leak or destroys the tightness of a valve. Using a valve disk or body that is too weak for the purpose for which it is used permits distortion of the disk or seat under pressure.

Leakages around threads of seat rings in bronze valves results in leakages through the valve. To correct the leakage, remove the seat ring, clean the threads, and remake the joint. Sometimes it is necessary to recut the threads in the valve and to replace the seat ring with a new one.

The use of wrenches to close valves tightly is not advisable, because valves are frequently sprung out of shape in this way. If a valve leaks or the stem sticks, the packing gland should be eased up so that the valve closes tightly without the use of a wrench.

Losses due to leakage which is not corrected mount up considerably, over a period of time. For example, over a period of a month a small 1/32-inch hole would waste 69,552 cubic feet of air at 100 psi, 3,175 pounds of steam at 100 psi, or 4,800 gallons of water at 40 psi.

Stuffing Box Leakage

Stuffing box leaks can be remedied by setting up on the gland, or by repacking it. The gland must not be set up on nor packed so tightly, however, that the stem binds. If the leaks persist after either or both of the remedies are applied, a bent or scored valve stem may be the cause.

Packing for the valve stuffing boxes may be either of the string type or of the ring type. String packing is ordinarily used for small valves in low-pressure systems; ring packing is used for large valves and for all high-pressure valves. When renewing the packing on any type of valve, be sure to use the correct size and type. The packing must be large enough to fill the space between the valve stem and the packing box, and it must be made of material that is suitable for the pressure and temperature conditions to which it will be exposed.

To pack a valve with a string packing, place successive turns of packing in the space around the rod. Bevel off the ends of the packing to make a smooth fit, and tighten the packing gland nut or the bonnet nut to compress the packing. String packing should always be wound in the same direction as the gland nut is to be tightened, so that the tightening of the nut does not cause the packing to fold back upon itself.

To pack a valve with ring packing, cut the ends of the rings square and even so that they make a level butt joint. Be sure to stagger the joints in successive rings.

In some gate, globe, angle, and stop-check valves, the stuffing boxes may be repacked under pressure, when necessary. These valves are so constructed that the stem is back-seated against the bonnet when the valve is wide open. High-pressure valves are provided with a pressure leak-off connection. The pressure leak-off connection is sealed to the outside with a pipe plug. Extreme care should be taken to see that the valve is firmly back-seated before the plug is removed.

Sticking Valve Stems

There are a number of conditions that may cause valve stem troubles. If the stuffing box is packed too tightly, or if the gland nuts are tightened unevenly, the valve stem is likely to stick or bind. Slacking up on the gland nuts relieves the packing pressure. Paint or rust on the valve stem, which also causes binding, can be removed by cleaning the stem.

Jamming the valve shut while it is cold results in the disk being bound tightly to the seat because of the expansion caused by the subsequent heating. To relieve the strain in a yoke valve, carefully slack off the yoke nuts; if the sticking valve is not a yoke valve, slack back slightly on the bonnet nuts. The disk can then generally be freed from the seat.

Jamming the valve open while it is hot may result in the valve being bound open, due to subsequent contraction. A valve that is bound open can usually be started toward the closed position with a wrench, though care must be taken not to spring the valve stem. After opening a valve wide, turn the stem a half revolution in the closing direction, and the danger of valve binding due to expansion is eliminated.

The valve may become stuck if the valve stem threads are burred from rough handling, or upset from pressure which has been applied to move the sticking valves. Distorted or burred valve stem threads are a serious valve trouble. If the valve cannot be moved by any other method, the bonnet must be removed, the stem cut out of the yoke or bonnet, and a new stem made. If the bonnet and yoke are damaged, they must be repaired. If the burred or upset threads are detected before the stem becomes stuck, they can be dressed smooth with a file, or machined in a lathe.

If the sticking is due to a bent valve stem, the stem must be either straightened or renewed.

All valves should be operated at least once a month to insure proper operation.

PUMPS

Due to their simplicity and adaptability to a wide variety of operating conditions, centrifugal pumps are widely used. They can be modified to operate over a wide range of heads, can handle liquids at all normal temperatures, and operate at speeds that are standard for motors or turbines. The characteristics of these pumps are such that liquid flow from them is continuous, and their discharge can be throttled without building up excessive pressures in the pumps or overloading the driving unit.

Wear occurs in a pump as in any other piece of machinery. To maintain a pump at or near the efficiency it had when new and to keep maintenance at a minimum, periodic tests should be made to determine the delivery capacity of the pump. When a test indicates a very noticeable reduction in the delivery capacity, it is a sign of possible internal wear. The pump should be opened for inspection. If remedial action is not taken immediately, total failure of the wearing parts may result, causing considerable shutdown time and excessive repair cost. The rotating element should be removed and all of the wearing parts checked for excessive clearance. Worn parts should then be replaced in order to restore the pump's original efficiency. Manufacturer's instructions should be followed.

The most common types of centrifugal pumps used in the aviation fuels service systems (both JP-5 and AvGas) are the Allis-Chalmers, Worthington, and Weil KU-5 sea water pumps. Allis-Chalmers pumps are used as JP-5 service pumps, aviation gasoline booster pumps, and as sea water pumps in the AvGas system. Worthington pumps are used for JP-5 service pumps and AvGas booster. The Weil KU-5 is strictly a sea water pump. All three centrifugal type pumps are described in this section.

JP-5 SERVICE PUMPS (ALLIS-CHALMERS)

The pumps most commonly used in the JP-5 service system are the Allis-Chalmers and Worthington centrifugal type pumps. Only the Allis-Chalmers is discussed in this section.

The Allis-Chalmers JP-5 Service Pump is a double-suction, single-stage, single-speed, centrifugal type pump. Double-suction means that fuel is fed to both sides of the impeller simultaneously. Single-stage means that the fuel passing through the pump is pumped one time only. Single-speed means that the pump impeller is rotating at one constant rpm.

Fuel entering the pump is fed into the center, or eye, of the impeller. Centrifugal force created by the rapid rotation of the impeller throws the fuel outward, away from the center, or eye, and into the pump casing.

The continued rapid rotation of the impeller produces flow velocity that drives the JP-5 out of the pump casing. The pump discharge nozzle, being smaller than the inlet, changes the velocity to a pressure head.

NOTE: For a more detailed description on theory of operation, refer to Fluid Power, NavPers 16193-B.

The pump has two basic component parts—the pump casing and rotating element.

Pump Casing

The pump casing houses and provides a working area for the rotating element. The casing (fig. 9-6) is split at the horizontal centerline. This facilitates easy removal of the upper casing half, for inspection, maintenance, and so forth, of the rotating element without disturbing the lower or fixed half.

The upper and lower casing halves are sealed by a 0.015-inch asbestos gasket.

The pump casing is divided into three chambers—two suctions (4) and one discharge (2). The dividing bulkheads (3), between each chamber, house the stationary wearing rings.

The stuffing boxes (5), located on each side of the pump casing, house the shaft seals.

The suction (1) and discharge (8) nozzles are cast integrally with the lower casing half; a drain hole (9) is provided at the bottom of each nozzle for draining the pump casing prior to maintenance.

The bearing housings (7) are on each end of the pump casing and are, also, cast integrally with the lower casing half. When the pump is assembled, the bearing adapters are fitted into the housings and secured in place by the bearing caps (6).

Two internal orifices are drilled into the upper casing half. These orifices extend from each side of the pump discharge compartment to the stuffing boxes. They provide fuel for cooling and lubricating the shaft seals. Three threaded holes are also provided in the top of the upper casing half, for installing a priming valve. Two of the holes are located one over each suction compartment and the third at the highest point of the discharge compartment.

NOTE: The priming valve is described later in this section.

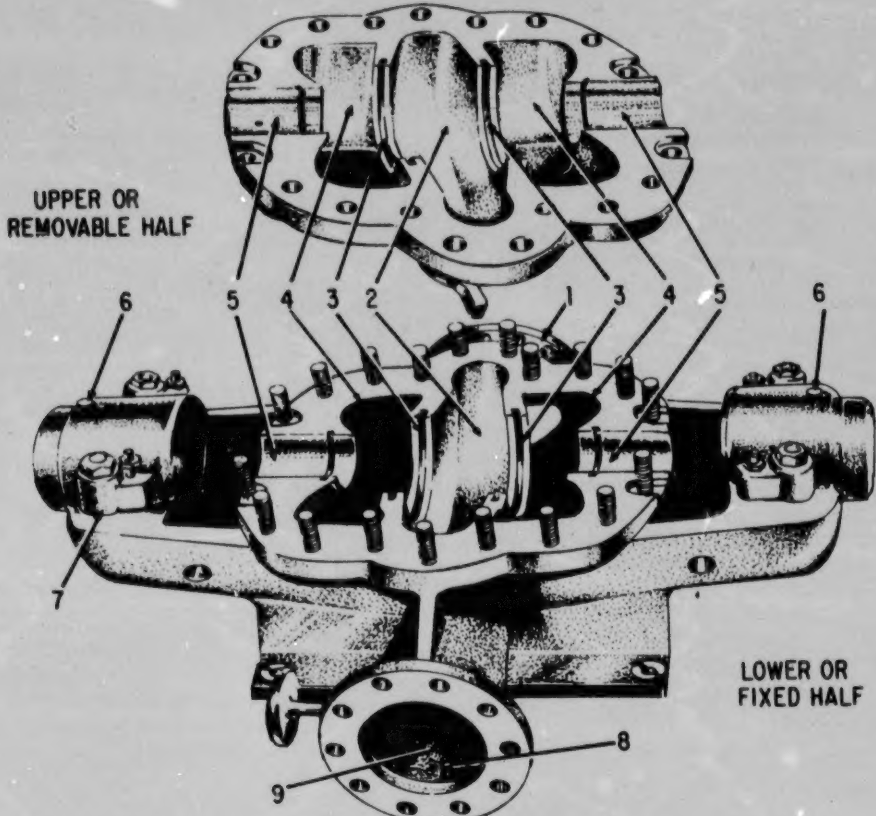
Rotating Element

The rotating element is shown in figure 9-7. The rotating element can be removed from the pump casing after removing the upper casing half and bearing cups and disconnecting the flexible coupling.

The pump shaft is connected to the electric motor shaft by an all-metal flexible coupling.

The impeller is of the double-suction, six-vane type. It is keyed to, and rotates with, the pump shaft. The impeller is centered in the discharge compartment of the pump casing and prevented from axial movement by two shaft sleeves and two shaft nuts. A replaceable type wearing ring is fitted on each side of the impeller. These rings are installed with a shrunk fit; that is, they are heated in oil before placing on the impeller, and then allowed to cool.

There are four replaceable type wearing rings—two rotating and two stationary installed within the pump casing. The two rotating are installed on the impeller. The two stationary are installed in the pump casing between the suction and discharge compartments. The stationary rings are held in place and prevented from rotation by the tongue-and-groove construction. When the pump is assembled, the rotating or impeller wearing rings ride inside the stationary ring. Impeller wearing rings are furnished oversize and must be machined after installation. Stationary wearing rings are furnished undersize and must be fitted to the impeller rings. When installed, there should be a radial clearance of 0.007 inch between the two rings.



1. Pump inlet.
2. Impeller housing and discharge chamber.
3. Housing for stationary wearing rings.
4. Inlet chamber.
5. Stuffing box.
6. Bearing caps.
7. Bearing housing.
8. Discharge outlet.
9. Drain hole.

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Figure 9-6.–Pump casing.

Wearing rings serve two purposes–(1) because of their unique construction and close tolerances, they minimize leakage between the discharge and suction compartments of the pump, and (2) they allow for the wear created between the impeller and pump casing.

Fuel passing through the pumps has a tendency to recirculate from the discharge compartment, back into the suction compartment, since there is no pressure at the "eye" of the impeller. As the fuel passes through the narrow clearance between the wearing rings, a partial seal is made by the rapid rotation of the impeller. This seal minimizes the leakage between the discharge and suction compartment of the pump. After prolonged use of the pump, the clearance between the wearing rings gradually increases due to wear. This is caused

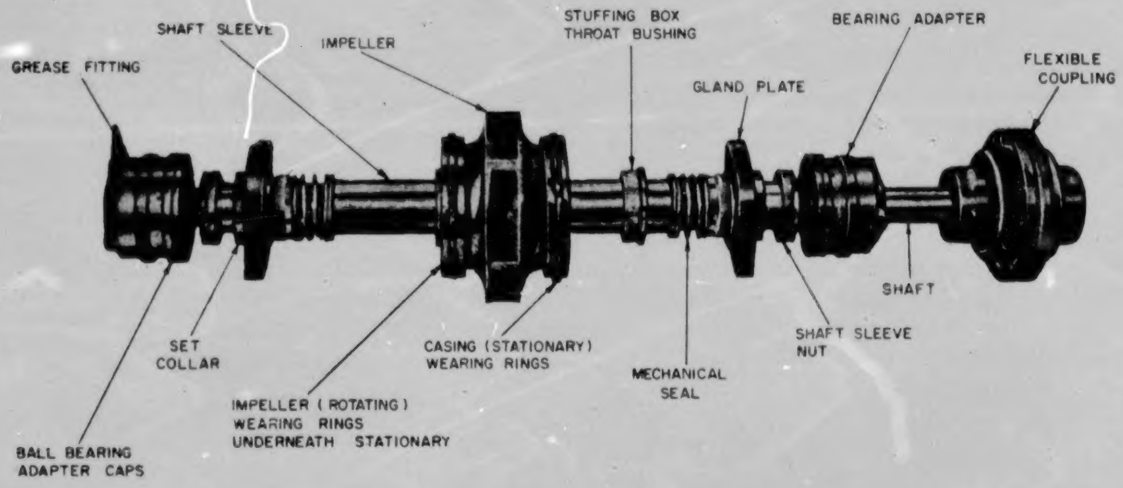
SHAFT SLEEVE
IMPELLER
STUFFING BOX
THROAT BUSHING
BEARING ADAPTER
GREASE FITTING
FLEXIBLE
COUPLING
GLAND PLATE
SHAFT
SHAFT SLEEVE
NUT
SET
COLLAR
CASING (STATIONARY)
WEARING RINGS
MECHANICAL
SEAL
IMPELLER (ROTATING)
WEARING RINGS
UNDERNEATH STATIONARY
BALL BEARING
ADAPTER CAPS

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Figure 9-7.—Assembled rotating element.

by the friction created by the rapid rotation of the impeller and the fuel passing between the wearing rings.

As the clearance increases between the wearing rings, the sealing effect decreases. This results in the loss of the rated capacity of the pump. Wearing rings should be replaced when the clearance reaches 0.014 inch. Therefore, instead of machining the pump casing and impeller to the required clearance of 0.007 inch and renewing one or both when the clearance reaches 0.014 inch, inexpensive wearing rings are furnished for this purpose.

The two shaft sleeves actually act as long spacers between the impeller and shaft sleeve nuts. Their inside diameter is slightly larger than the pump shaft, therefore allowing free movement along the shaft.

They are used in conjunction with the shaft nuts to center and secure the impeller in the pump casing. By backing off on one shaft nut and tightening the opposite, the impeller can be moved axially along the shaft as necessary. Before installing the shaft sleeves, the shaft is coated with a mixture of white lead and oil. This prevents leakage of air into, or fuel out of, the pump casing between shaft sleeve and pump shaft.

An additional seal is also made for this purpose by wrapping the shaft (between the shaft sleeve and shaft nut) with boot cord. The shaft sleeves and nuts are recessed to provide installation of the boot cord. Prior to installing the boot cord, it is impregnated with No. 2 permatex. NOTE: O-ring seals are used on some pumps in place of boot cord.

The shaft sleeves are keyed to and rotate with the pump shaft. They are secured in place and prevented from axial movement by the two shaft nuts.

The shaft nuts are designed with an enlarged collar and act as additional slinger rings. If any JP-5 should leak out of the pump along the shaft, it will be flung outward away from the bearing housing. A spanner wrench is required to adjust the shaft nuts.

NOTE: Several ships have experienced damage to the pump, caused by the shaft nuts backing off while the pump was in operation. It is recommended that the nuts be drilled and tapped to facilitate installing headless set screws. This provides a means of locking the nuts in the secured position.

One set of ball bearings is installed on each end of the pump shaft. They support the shaft assembly and insure free rotation. Each set of bearings consist of two matched, single-row ball bearings. The ball bearings are slipped on and held firmly against a shoulder on the pump shaft by a lockwasher and locknut.

NOTE: Heat new bearings in oil at temperature of 180° F before installation.

Cup-shaped bearing adapters fitted with a grease fitting, are slid over the outer races of the ball bearing. The bearing grease is retained inside by adapter caps installed on the inboard end of the adapters.

Leakage of air into, or fuel out of, the pump casing, along the shaft, is prevented by two John Crane mechanical seals. (See fig. 9-8.) The seals are installed in the stuffing boxes provided on each side of the pump casing. The principal parts of the John Crane seal are the stationary floating seat, low-friction sealing washer and bellows assembly, and spring.

The stationary floating seat consists of a metal ring contained within a synthetic rubber ring. This assembly is housed in the stuffing box gland plate. The inboard or mating surface of the metal ring has a lapped face. The synthetic rubber ring eliminates stress and allows easy removal of the seat when necessary.

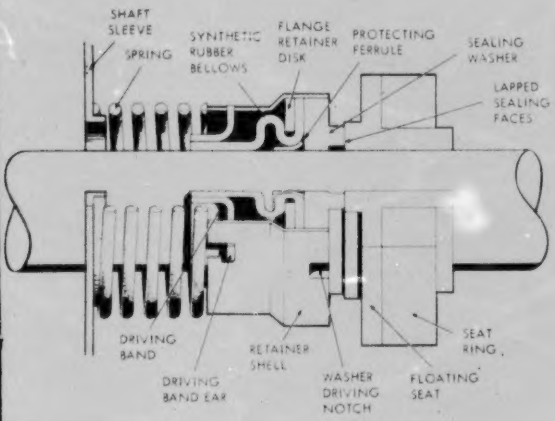

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Figure 9-8.—Aviation fuel pump shaft seal.

The low-friction sealing washer is made of carbon. It is held in place in the retainer shell by identations in the washer and notches in the shell. The outboard end or mating surface of the carbon seal has a lapped face.

CAUTION: Handle the carbon seal with care, as it breaks very easily.

The synthetic rubber bellows serves two purposes—(1) the outboard or bellows end expands to compensate for the wear of the carbon seal, and (2) the inboard or driving end grips the shaft and provides the driving force for the mechanical seal.

The outboard end of the bellows is secured between the flange retainer disk and the carbon seal. The metal protecting ferrule prevents the flexing fold of the bellows from contracting the pump shaft, thereby assuring free movement of the bellows at all times. The inboard end of the bellows grips the shaft and, once seated, does not move. Protruding rubber fingers from the inboard end of the bellows interlock with holes in the metal driving band. Projecting ears from the metal driving band interlock with the oblong slots in the retainer shell. This, therefore, interlocks the low-friction sealing washer and bellows assembly with the pump shaft.

The spring, fitted with spring keepers on each end, butts against a shoulder on the shaft sleeve and the inboard end of the retainer shell. When the stuffing box gland plate is in proper position, the spring is compressed. This maintains tension on the retainer shell, which in turn insures constant contact of the low-friction sealing washer with the stationary floating seat.

An O-ring is installed between the stuffing box gland plate and the pump casing.

The John Crane mechanical seal is a spring-loaded, friction type seal. All parts of the seal rotate with the shaft, except the stationary floating seat.

Maintenance

To insure that the pump gives the most trouble-free life and availability, it must be serviced and maintained properly.

Before any maintenance is performed, refer to the manufacturer's technical manual and also the applicable MRC's; have the ship's electrician secure all electrical power to the pump before disassembly of the pump.

To disassemble the JP-5 service pump for inspection and removal of the rotating elements:

1. Secure the electric power to the pump. (Remove fuse.)
2. Remove the priming valve.
3. Unbolt and remove the upper casing half.
4. Disconnect the all-metal flexible coupling.
5. Unbolt and remove the bearing caps.
6. Lift the rotating elements out of the lower casing half.

MAINTENANCE OF WEARING RINGS.–Wearing rings are inspected annually and replaced when a radial clearance of 0.014 inch or more is reached.

NOTE: Wearing rings are replaced by the ship's machine shop.

MECHANICAL SEALS.–Mechanical seals require no maintenance, but should be replaced whenever leakage occurs, or whenever the sealing surfaces have been disturbed.

INSTALLATION OF THE JOHN CRANE MECHANICAL SEAL.–Since the mechanical seal is installed over the shaft sleeve of the Allis-Chalmers pump, the impeller should first be centered in the pump casing. Any further axial movement of the shaft sleeve after the seal has been positioned affects the proper operation of the seal.

To install the shaft seal, proceed as follows:

1. Slide the spring, with spring keeper in place, over the shaft sleeve.
2. Apply a light coat of clean oil to the bore of the rubber bellows. Slide the bellows assembly on the sleeve until the spring keeper comes in contact with the shoulder on the sleeve. A slight rotating motion will assist in this operation. DO NOT COMPRESS THE SPRING.
3. Apply a small amount of oil to the capped faces of the carbon seal and stationary floating seat. Then slide the gland plate, with floating seat and O-ring in place, over the sleeve until it is in contact with the bellows assembly.
4. Slide the outer set collar piece up against the gland plate. The collar is provided with headless setscrews for securing it to the shaft, once the gland plate is in its proper position.

By use of a spacer and the shaft sleeve nut, jack the entire assembly into the shaft sleeve until an exact distance between the face of the gland plate and the shoulder on the shaft sleeve is reached.

CAUTION: DO NOT EXCEED THE EXACT DISTANCE. To retract the bellows is very difficult, if not impossible, without damaging the seal. Slide the set collar up against the gland plate and lock it in position. The mechanical seal is now in the same position as it will be when installed in the stuffing box.

NOTE: Since the exact distance required between the face of the gland plate and the shoulder on the sleeve varies for various pumps, refer to the manufacturer's technical manual for the proper distance on the pump in question.

Allow 5 or 10 minutes for the inboard end of the bellows to grip the shaft. During this time, remove the spacer used to jack the seal in place, and install the remaining component parts of the rotating assembly on the pump shaft, such as bearings, bearing adaptors, and so forth.

Just prior to lowering the entire rotating assembly into the lower casing half, unlock the set collar and slide it back against the raised collar on the shaft nut. Relock it in this position. The gland plate can now be slid back away from the shaft seal, allowing the assembly to be lowered in position.

NOTE: The set collar is used only to hold the mechanical seal in place during the preloading period of the inboard end of the bellows to the pump shaft. It serves no other useful purpose.

GASKETS.–Take great care when cutting the casing gasket to cut closely around all tongue-and-groove joints. Do not use a hammer to cut the gasket, as this changes the machined surfaces.

ASSEMBLY OF THE PUMP.–The pump is assembled in reverse order of disassembling.

When lowering the rotating assembly into the lower casing half, insure that the stationary wearing rings, the stuffing box throat bushings, and the bearing adaptors are properly alined. The component parts of the rotating assembly must fit perfectly into the recesses provided in the lower casing half. The shaft should turn freely both before and after the upper casing half is tightened in place.

LUBRICATION.–The importance of proper lubrication of the ball bearings cannot be over-emphasized. It is impossible to say how often a ball bearing should be greased, since this depends on the condition of operation. It is well to add 2 or 3 ounces of grease at regular intervals, but it is very important to avoid adding too much grease. Overgreasing is the most common cause of overheating of ball bearings.

For grease lubrication, a regular ball bearing grease should be used. Do not use graphite grease.

Great care must be exercised to keep the bearing housing perfectly clean and only clean grease should be used. Foreign solids or liquids invading the bearing housing completely destroy the bearings in a short time.

NOTE: Do not operate the pump without the suction piping and casing being completely filled with liquid. The wearing rings, the throat bushing, and the mechanical seal require JP-5 for lubrication.

Running the pumps dry will damage the wearing rings, throat bushings, and mechanical seals.

NOTE: Refer to chapter 3 for proper operation of the pump and the pump controllers.

NASH VACUUM PRIMING PUMPS

The Nash vacuum priming pumps are used to produce a vacuum in the vacuum tank, (fig. 9-9). When in operation (priming), each pump draws a vacuum of 20 inches Hg. at 30 cfm. They are of the double-suction, rotor-type, centrifugal pump. These pumps operate on the water piston principle and require a continuous supply of clean sealing water while in operation. The tank on which the pumps are mounted provides a suitable reservoir for the seal water, and also a substantial base for the pump.

The seal water tank is maintained two-thirds full of fresh water at all times. A sight glass gage is provided for determining the water level within. The tank is fitted with a fill plug at the top and a drain plug at the bottom. An atmospheric vent is provided at the top to allow for the escape of air discharged into the tank by the priming pumps. The priming pump discharge piping enters the tank at the top and terminates near the bottom.

Sealing water for the priming pumps is provided through the seal suction line. This line extends from the bottom of the seal water tank to the suction (inlet) piping of the pumps. The seal suction line contains a 1/16-inch orifice which regulates the flow of sealing water. A "Y" strainer, located between the orifice and the bottom of the tank, prevents fouling of the orifice.

A vacuum relief valve and a vacuum gage are installed in each primary pump suction line adjacent to the pumps.

The pump consists of four major component parts as shown in figure 9-10.

The rotor, a series of curved blades, applies centrifugal force for the seal water.

The lobe is an elliptical-shaped outer casing for the rotor.

The port plate contains two inlet ports and two discharge ports. It directs the suction and discharge flow to and from the rotor.

The bracket provides a means of connecting the priming pump suction line to the two inlet ports in the port plate and the pump discharge line to the two discharge ports in the port plate.

The priming pumps are built integrally with the electric motor; therefore, the electric motor drive shaft is also the pump drive shaft.

Theory of Operation

Assume that the lobe (pump casing) is properly filled with seal water, and follow through a complete cycle of operation of the rotor by referring to figure 9-11. Start with chamber (1); assume that the casing has adequate seal water. Rotation of the rotor

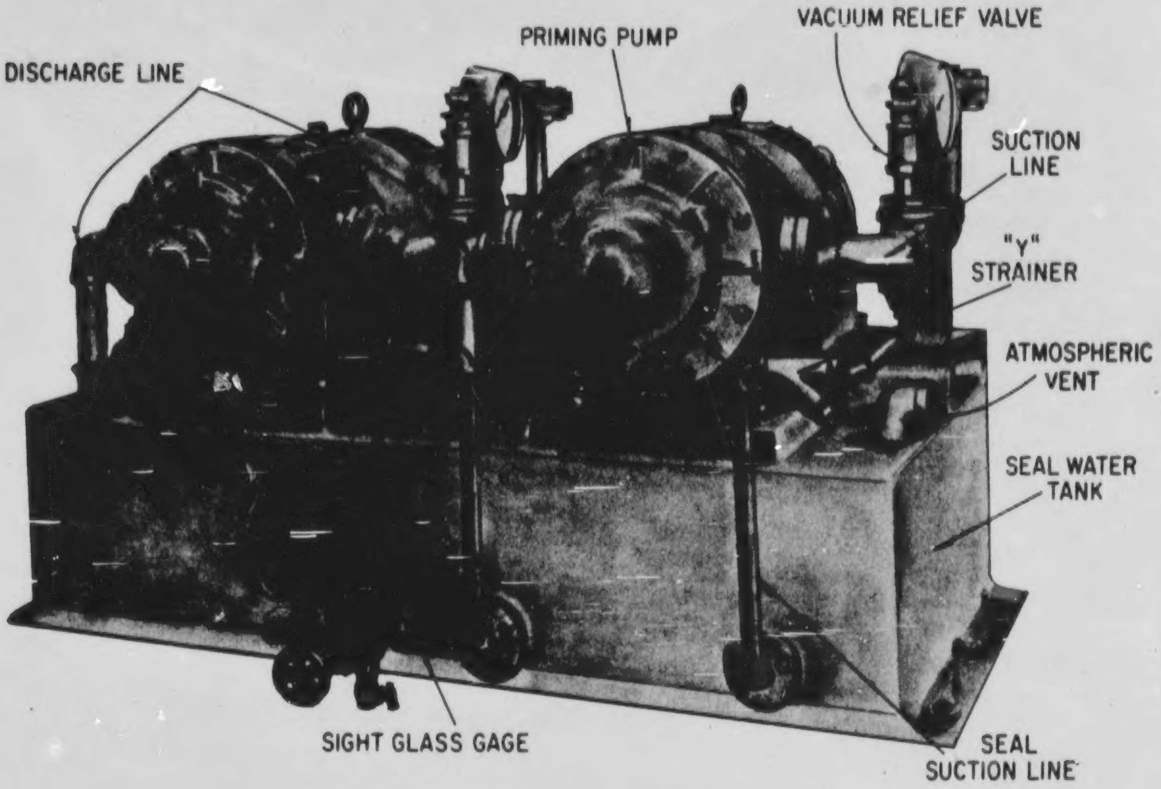

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Figure 9-9.—Nash vacuum priming unit.

throws the seal water away from the rotor hub by centrifugal force. The seal water traveling at the same speed as the rotor follows the pump casing and forms an elliptical-shaped ring. As the water ring and rotor revolves past the inlet port, the water, due to centrifugal force, moves away from the hub of the rotor, thus creating a vacuum, which in turn draws air in through the inlet port and pump suction piping to fill the space the water previously occupied. At (2) the seal water has been thrown outward from the chamber in the rotor and has been replaced with air. As rotation of the rotor and seal water continue, the converging wall of the casing forces the water (3) back into the chamber of the rotor, trapping the air in the chamber. As the rotor and water ring advance toward the discharge port, the space between the water and the hub of the rotor progressively decreases and forces the air out through the discharge port and the pump discharge piping. At (4) the chamber of the rotor is again full of seal water and is ready to complete the cycle in the lower sections of the pump.

The elliptical-shaped ring of water (caused by the rotation of rotor), revolving within the lobe, moves in and out from the hub of the rotor, forming a liquid piston. This is similar to the movement of a reciprocating piston, hence the "water piston principle." Some of the seal water is discharged out with the air during each cycle. Therefore, in order to maintain the water seal ring in the pump, fresh seal water is continually being drawn in through the pump's seal suction line, connected to the priming pump

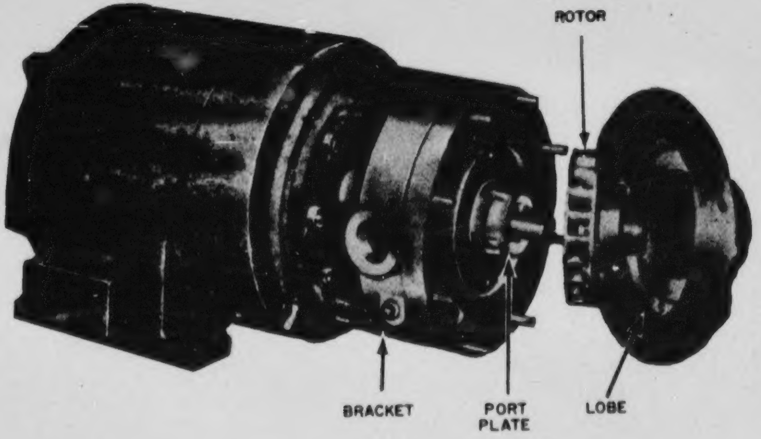

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Figure 9-10.—Nash vacuum pump.

suction line. Flow of this replenishment water is regulated by the 1/16-inch orifice in the seal suction line.

The priming pumps are connected in series to enable them to be operated automatically, either singly or both simultaneously as necessary, and to maintain a minimum vacuum within the vacuum tank. One pump is designated the in-use and the other the standby pump.

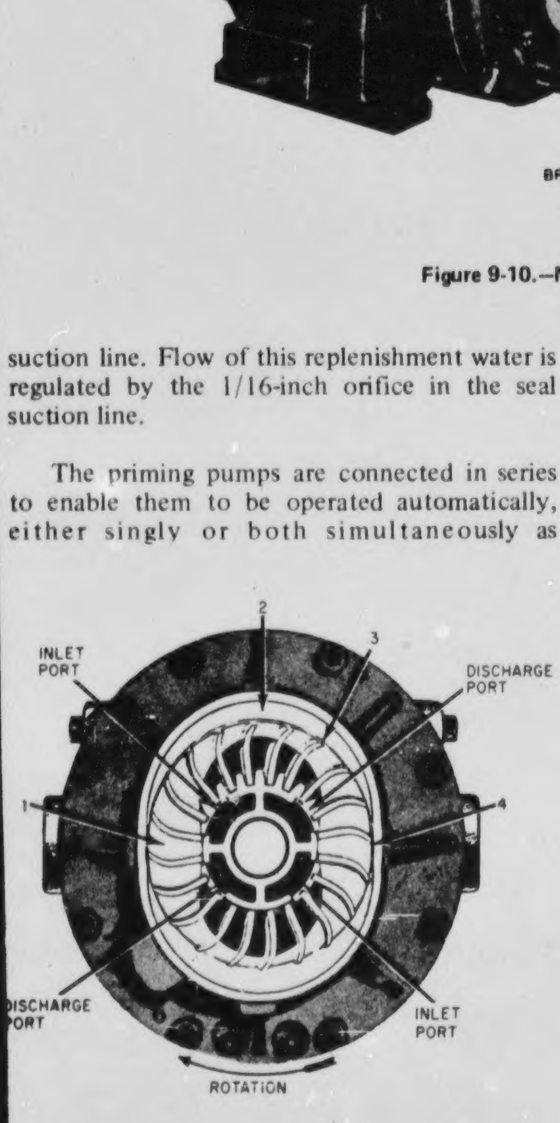

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Figure 9-11.—Cutaway view of interior.

Initial Priming of the System

To prime the pump initially, remove the vacuum relief valve and fill the pump with clean, fresh water. This can be done while filling the seal water tank to two-thirds full.

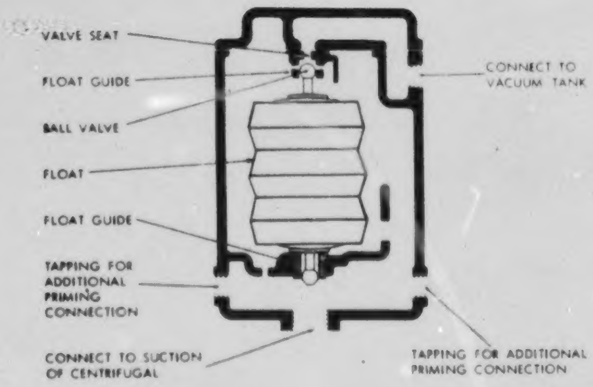
CAUTION: NEVER turn the pump through under power without seal water in the pump casing, or serious damage will result.

The pump starts to remove air in a few seconds after operation. The length of time it takes to initially prime a system depends on the length of piping in the system.

Priming Valves

The float-operated priming valves (fig. 9-12) are located in the suction line between the vacuum tank and the centrifugal pumps. Each valve is installed above the highest point of the pump casing.

Three lines from the uppermost part of the pump casing join together to form one common line into the lower section of the priming valve


VALVE SEAT
FLOAT GUIDE
BALL VALVE
FLOAT
FLOAT GUIDE
TAPPING FOR ADDITIONAL PRIMING CONNECTION
CONNECT TO SUCTION OF CENTRIFUGAL
CONNECT TO VACUUM TANK
TAPPING FOR ADDITIONAL PRIMING CONNECTION

198.86

Figure 9-12.—Priming valve.

body. One line extends from the top of each suction compartment. The line from the discharge compartment is fitted with a globe type shutoff valve.

CAUTION: This valve must be closed after priming and before starting the centrifugal pumps as the discharge pressure will damage the float.

There are two component parts to the priming valve—the float and the float chamber.

The float is made of copper or synthetic rubber and designed to float in JP-5 and drop to the bottom of the chamber when air is present. Guide rods, top and bottom, center the float in the float chamber. The end of each guide rod has a metal ball. The top ball acts as a valve disk; however, both balls are identical and either can be installed at the top.

The float chamber is divided into two bolted sections. The body (bottom section) contains the pipe connection to the pump casing at the bottom and the pipe connection to the vacuum tank suction line at the top. This section also houses the float and contains the guide for the lower float guide rod.

The cover (top section) contains the guide for the upper float guide rod, the valve seat, and the discharge port for the air. The valve seat has a rubber seat ring. A gasket is installed between the top and bottom section of the valve chamber.

When air or vapor is present, the float is down, lowering the valve disk away from the valve seat, opening the discharge port. This allows the vacuum tank access to the pump casing. As the vacuum tank removes the air and vapor, JP-5 fills the pump casing and enters the priming valve chamber. As the JP-5 enters the inner valve chamber, the float rises, forcing the valve disk against the rubber seat, and closes the discharge port. This prevents JP-5 from entering the vacuum tank.

As additional air in the centrifugal pump casing or suction line is separated out and trapped in the valve chamber, the float immediately drops and allows the air to be removed by the vacuum tank.

Refer to chapter 3 for the priming system piping arrangement and for proper operation of the system.

Maintenance of the Priming System

The most important single suggestion concerning care of priming equipment is cleanliness. Clean sealing liquid must always be provided in the priming pump and seal tank for proper operation of the unit. The priming valve in the suction line from the priming pump tends to prevent contamination of the sealing liquid from the liquid handled by the centrifugal pump. Any small particles of dirt which can be carried in the airstream during priming are passed through the priming valve into the priming pump and into the seal system. Also, dirty liquid enters the bottom of the priming valve and on occasion it is possible that particles from this source pass over through the priming lines into the priming pump itself. It is therefore, essential to clean the priming valve interior periodically.

The inlet check valve adjacent to the primin pump inlet should be inspected and cleaned since any accumulation of dirt on the valve sea prevents complete closing of valve and ma cause backward flow of air into the centrifuga pump suction when the primer is shut down.

The seal tank should be drained and flushe out occasionally; as sediment tends to collect a the bottom, the sediment is indicated in the gag glass. If perchance the priming system become flooded with JP-5, it is necessary to completely flush out the system and refill the seal tank with clean, fresh water.

The only attention necessary, other than mentioned above, is to the packing. This should be checked from time to time and repacked as needed. The stuffing box glands should never be more than finger-tight. The stuffing box is under vacuum; consequently, leakage along the shaft is inward. Any continuous loss of water through the packing would indicate the need for taking up slightly on the stuffing box gland or repacking.

INSPECTING PRIMING VALVE INTERIOR.—To inspect the priming valve, remove the cover. Take the float out from the body and drain the body to inspect and clean the interior. Check the hole to the right of the guide bushing for clogging. The ½-inch vent connections at the bottom of the valve body should be checked for good seating in order that JP-5 does not pass out of the valve when the float is in the closed position. Both the valve seat and the float may be reversed in their position, since top and bottom are the same, in the event damage or wear has occurred on these parts. In replacing the float in the body, it is essential that the body is drained in order that the float centers itself properly.

ADJUSTING THE VACUUM RELIEF VALVE.—This valve is an emergency device, preventing excess vacuum beyond that necessary to properly prime the centrifugal pumps. It prevents the primer from operating against shutoff vacuum, thus saving horsepower. It further prevents water logging of the priming pump, thus reducing the priming time. The relief valve should be set to admit air at a vacuum of 22 inches Hg.

To change the vacuum setting, first loosen the locknut. To have the valve relieve at a higher vacuum, tighten the valve seat to the desired point. To lower the vacuum relief point, loosen the valve seat. Finally, lock the valve seat in position by tightening the locknut holding the valve seat.

For disassembly and assembly of the Nash vacuum primer pump, refer to the technical manual on the pump involved.

AVIATION GASOLINE BOOSTER PUMPS

The most common types of aviation gasoline booster pumps are the Worthington and Allis-Chalmers. Only the Worthington pump is described here.

Worthington Pump

There are several different capacities of Worthington pumps used in the aviation fuel system. However, except for their rated capacities and various discharge pressures they differ only in physical size.

The Worthington pump (fig. 9-13) is similar in many respects to the Allis-Chalmers. It, too, is a horizontal, single-stage, single-speed, double-suction, centrifugal pump.

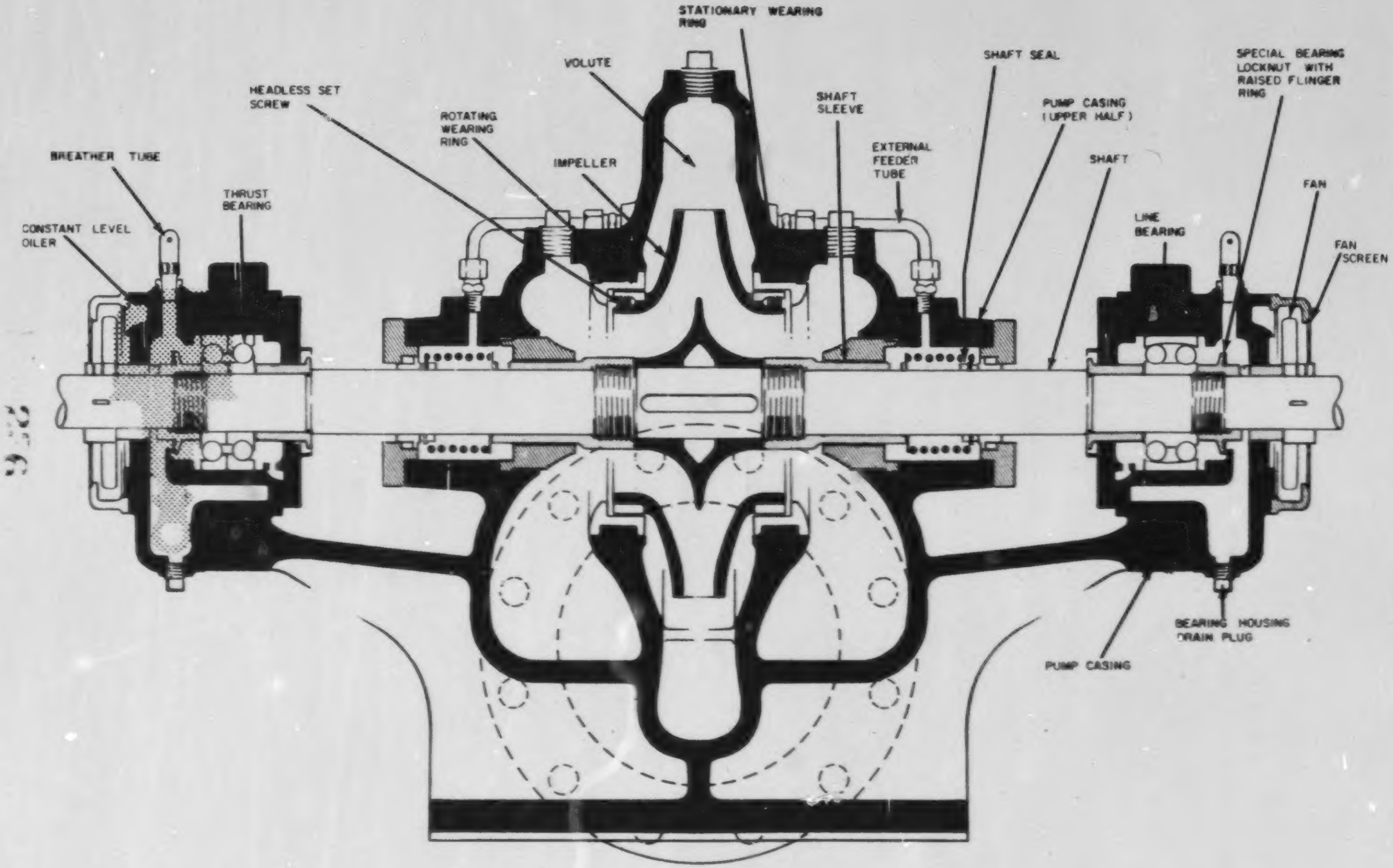
The pump casing consists of two parts, allowing easy access for inspection and repair without disconnecting the main piping. The horizontal split of the casing halves is sealed by a 1/32-inch-thick compressed asbestos sheet gasket.

The double-suction impeller is keyed to the shaft and centered in the volute by the shaft sleeves. The shaft sleeves are screwed onto the shaft and prevented from axial movement by setscrews.

Renewable type wearing rings are provided at the suction inlet side of the impeller. The two rotating wearing rings are secured to the impeller by headless setscrews and the two stationary are secured in the casing by the tongue-and-groove method. When new, there is 0.007 inch radial clearance between wearing rings. Wearing rings should be replaced when the clearance reaches 0.014 inch.

Leakage of air into or fuel out of the pump, along the shaft, is prevented by two mechanical seals. The seals are lubricated through external feeder lines from the discharge compartment to the stuffing box.

The pump shaft is supported by two sets of ball bearings which are housed in the lower casing half. One set (line-bearing) nearest the motor is a double-row, self-alining type. The other (thrust-bearing) consists of two single row, duplex-mounted angular type ball bearings. Light press fits are employed for mounting the


STATIONARY WEARING RING
VOLUTE
HEADLESS SET SCREW
ROTATING WEARING RING
IMPELLER
BREATHER TUBE
THRUST BEARING
CONSTANT LEVEL OILER
SHAFT SLEEVE
EXTERNAL FEEDER TUBE
SHAFT SEAL
PUMP CASING (UPPER HALF)
SHAFT
SPECIAL BEARING LOCKNUT WITH RAISED FLINGER RING
LINE BEARING
FAN
FAN SCREEN
BEARING HOUSING DRAIN PLUG
PUMP CASING

198.87

Figure 9-13.—Worthington AvGas booster pump.

bearings on the shaft. Each bearing assembly is held in place by a special bearing nut, which is secured by safety setscrews.

Line-and thrust-bearing sets of ball bearings are oil-lubricated by constant-level oilers which provide constant lubrication. The oil is circulated by means of a flinger ring on the special bearing nut. A breather tube is installed on top of the bearing housing to permit the escape of oil vapors. The bearings are fan-cooled. Proper oil level for bearings is 1¼ inches below centerline of the shaft. This level is maintained by the constant-level oilers, provided the oilers have been properly supplied.

The pump and motor shafts are connected by a flexible, all-metal, double-engagement, gear-type coupling. A gasket is provided between the coupling halves. The flexible coupling is not a universal joint. The same care should be exercised in alinement as if it were a rigid coupling. Put 2 ounces of SAE 90, Navy Symbol 3080, oil in the coupling through one of the plugs provided before operations. The coupling should be inspected periodically to insure that the proper amount of oil is maintained at all times.

The highest points of the discharge compartment (volute) are provided with a vent line which terminates in the discharge header.

In starting the pump, the following procedure should be adhered to:

1. Check the oil level in the constant-level oiler.
2. Turn the pump through by hand. Check for alinement and binding.
3. Open pump vent, suction, discharge, and recirculating valves and ascertain that there is a positive suction head produced by the operation of the sea water pump.
4. Start the motor.
5. After the pump has started, close the vent valves. Watch the pressure and temperatures. The bearings and stuffing box should be watched for overheating.

A safe temperature of the stuffing boxes ranges from 120° to a maximum of 140° F. The thumb rule for checking this temperature is to hold the bare hand over the stuffing box momentarily; if it is not too hot to touch, it is within the safe operating range.

This rule does not hold true for all oil-lubricated bearings, however, as they can still be within the safe operating range and still be too hot to touch, as is the case of the bearings in this pump, with a maximum of 160° F.

For a more accurate measurement, use a portable thermometer. Apply a small amount of duct seal (which is a plastic compound used by electricians to seal holes around wiring) on top of the bearing housing. The duct seal holds the thermometer in place while the reading is being observed. Duct seal is like putty, but does not stick to your hands, get hard, or melt when applied to a hot surface.

6. Cooling of the pumps is provided by the movement of aviation gasoline through the pump casing during pumping operation. In a standby operating condition, the recirculating line to the drawoff tanks recirculates 5 percent of the rated capacity of the pump. The maximum allowable temperature of the aviation gasoline passing through the pumps is 100° F, as indicated by a thermometer installed in the discharge header.

For easy access in inspecting the pump impeller and wearing rings, remove the top half of the pump casing. This is accomplished by—(1) draining the pump casing, (2) removing the vent line (3) removing the nuts and pushing the seal cover chamber clear of the pump casing, and (4) withdrawing all bolts and nuts from the casing and removing the top half carefully to prevent injury to the internal parts. If the wearing rings or impeller need replacing, drain the bearing housing and the flexible coupling. Disconnect the flexible coupling, remove the bearing housing straps, and then lift out the shaft and impeller assembly from the lower half of the casing. For further disassembling and maintenance, refer to the manufacturer's manual. To reassemble, repeat the above operation in reverse order. If a new gasket is required, use the same thickness and material as originally installed. DO NOT mark the outline of the gasket with a hammer or other metal object, as this damages the edges and corners of the machined surfaces and prevents proper sealing.

To install the new gasket, the edges must be trimmed squarely and neatly. Clean the casing flanges properly before installing the gasket to the lower half of casing. Care must be exercised in disassembling and reassembling the pump. Handle the wearing rings and impeller carefully. These parts must not be dropped or forced into place, since any force applied results in distortion, thus causing rubbing during operations. The impeller must be centered in the volute before replacing the upper half of casing.

SEA WATER PUMPS

Sea water is supplied to the hydraulic gasoline system by the centrifugal pumps. The two most commonly used pumps for this purpose are manufactured by the Weil Pump Company and the Allis-Chalmers Manufacturing Company.

Weil KU-5 Sea Water Pump

The Weil KU-5 sea water pump is of the single-suction, centrifugal type. It is made up of three main sections—the suction plate, pump casing, and shaft support. (See fig. 9-14.)

The suction plate provides a connection for the pump inlet piping and access to the impeller when removed. One of the stationary (casing) wearing rings is press-fitted into the inside of this plate. The suction plate is bolted to the pump casing and sealed by a 1/32-inch sheet asbestos gasket.

The pump casing, which houses the impeller, contains the other stationary (casing) wearing ring which is also press-fitted into it. The two rotating wearing rings are heat shrunk onto the six-vane bronze impellers (one on each side) and ride inside the two stationary rings. When the new wearing rings are installed, they should be machined down to obtain a clearance of 0.008

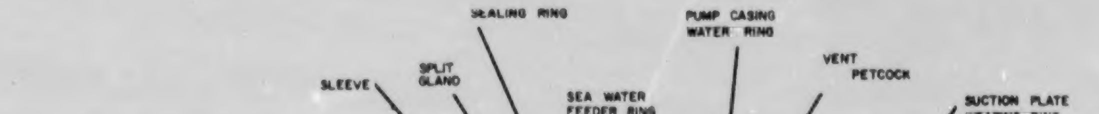

SEALING RING
PUMP CASING WATER RING
VENT PETCOCK
SPLIT GLAND
SLEEVE
SEA WATER FEEDER RING
SUCTION PLATE WEARING RING
DOUBLE-ROW SHIELD BEARING
IMPELLER WEARING RING
IMPELLER
GREASE CUP
IMPELLER HOLES
WOODRUFF KEY
THROAT BUSHING
SHAFT SUPPORT
PUMP CASING
SUCTION PLATE

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Figure 9-14.—Weil sea water pump.

inch. When the clearance between the rings reaches 0.016 inch or better, they must be replaced. The impeller is keyed to the shaft and secured by a brass locknut. Holes are drilled through the impeller, near the base, to permit the inlet pressure to equalize all around the impeller. This reduces the thrust load on the impeller and the shaft. Leakage of water from where the shaft passes through the pump casing is prevented by a stuffing box. The stuffing box is cast integrally with the pump casing. It contains an inner throat bushing, four rings of 3/8-inch-square, semimetallic, graphite impregnated, asbestos packing, a brass seal ring, and a split packing gland. The packing gland is split for easy removal, so the packing can be replaced without dismantling the pump. The packing is retained in the stuffing box by the inner throat bushing on the impeller side and the split gland and clamp on the outboard side. Water for cooling and lubricating the packing enters the stuffing box through the seal ring, which is located between the first and second inner packing ring. The water is supplied through a copper feed line which extends from the pump discharge compartment to the stuffing box. When the pump is operating the water also forms a seal around the pump shaft to prevent drawing air into the pump casing.

The shaft support is bolted to the pump casing. It contains two sets of double-row single-shield ball bearings. The ball bearings support the outer end of the pump shaft and absorb both the radial and thrust loads developed in the pump. Lubrication of the bearings is provided by screwdown grease cups. The portion of the shaft that passes through the stuffing box is machined down and fitted with a sleeve. This saves replacement of the entire shaft due to wear or scoring caused by faulty packing.

The pump shaft passes through a stuffing box in the bulkhead and is connected to the motor shaft by an all-metal flexible coupling. The bulkhead stuffing box contains six rings of 3/8-inch-square packing (three on each side), two packing glands (one on each side), and one grease cup for each gland. The packing around the shaft keeps gasoline vapors from entering the motor room.

MAINTENANCE.–In operation, there may be times when the pump fails to pump liquid or fails to put out its rated capacity. Some of the probable causes for these failures are pump not primed (airbound); valves closed or partially closed; wrong rotation, and wearing rings worn excessively. Proper maintenance and operation decrease the possibility of the above-mentioned troubles.

Some mechanical defects that might occur and cause the pump to malfunction are a bent shaft; the pump and motor shafts not properly alined; the bearings overgreased; the bulkhead stuffing box too tight, causing heat; the water seal clogged in the pump stuffing box; the leakage at the pump stuffing box excessive; or worn bearings.

For protection from an excess of lubrication and dirt, single-shield type ball bearings are used in this pump. It is impossible to state how often to grease ball bearings because the frequency depends upon the unit's use. However, it is a general rule on bearings provided with the screwdown grease cup to turn the cup down one-quarter turn each time the unit is used. Watch for evidence of overgreasing (as well as undergreasing) as this is one of the most common causes of overheating.

When it becomes necessary to replace the wearing rings they must be machined out or off and new rings pressed in place without removing the part from the lathe. The new rings are then turned to the proper diameter. This is done to maintain the accurate alinement with mounting checks and bores.

The stuffing box packing should be changed occasionally. If the seal ring remains undisturbed for long periods of time, it becomes corroded by sea water and is difficult to remove. If this occurs it may be necessary to apply air pressure at the feeder line connection and blow the ring out.

CAUTION: Wrap rags around the pump shaft to prevent damaging the base ring when it is blown clear.

Packing for the pumps should be cut diagonally. Each ring should be of the proper length so that the ends do not overlap when placed around the shaft and pushed into the box. A small amount of oil may be applied to the pump shaft and the stuffing box surface to ease the insertion of the packing rings. Oil also minimizes the possibility of scoring the sleeve if the packing is too tight.

Place the first ring of packing in the stuffing box and bottom it against the throat bushing (using a blunt instrument). Then install the seal water ring.

CAUTION: The seal water ring must be positioned directly underneath the feeder line hole in the stuffing box housing. It may be necessary to install two rings of packing in some pumps before installing the seal rings.

Install the remainder of the packing rings, staggering each joint approximately 90° to the previous one. The packing should not be pressed too tight on installation as this may result in burning the packing or scoring the sleeve. If the pump rotor cannot be turned by hand the packing is too tight. When starting the pump the packing gland should be slightly loose (finger tight) but not so loose that air is drawn into the pump. With the pump running the gland should be drawn up evenly until the stuffing box leakage is two or three drops of water per minute.

Allis-Chalmers Sea Water Pumps

The Allis-Chalmers sea water pumps are identical to the JP-5 and AvGas Allis-Chalmers pumps, except for the packing in the stuffing box. The sea water pumps use the Fleximetal type packing. There is one other slight difference in that the lower capacity pumps are provided with external feeder lines vice internal on the 1,000 gpm sea water pumps. (See fig. 9-15.)

Except for the number of packing rings required in the stuffing box and their arrangement, the stuffing box assembly is basically the same as the Weil KU-5.

The Allis-Chalmers pumps require five rings of asbestos packing installed as follows—two rings of packing, the seal water ring, and three additional packing rings. Due to the limited space between the stuffing box and bearing housing on these pumps, the seal water ring is also split for easy removal when replacing packing.

The wearing ring clearance is also the same as for the Weil KU-5.

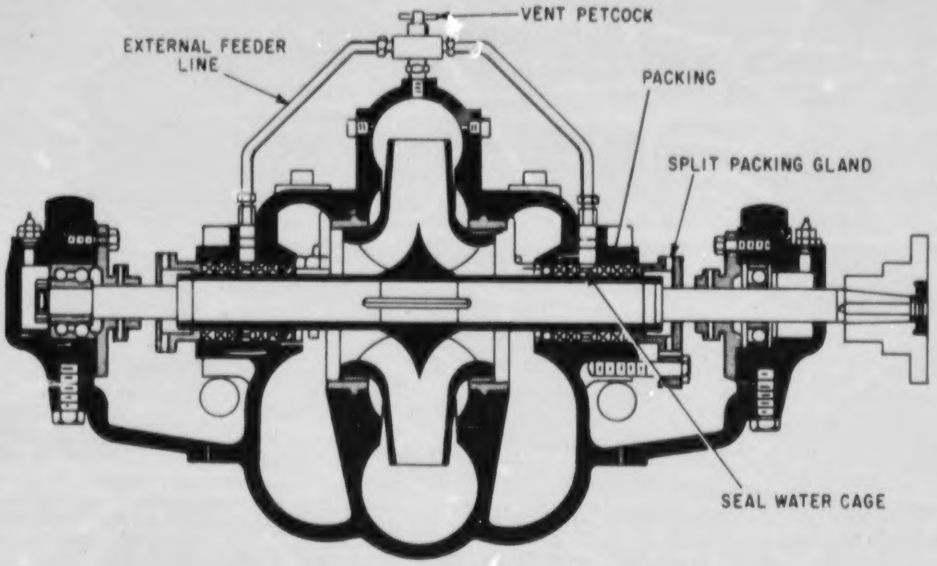

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Figure 9-15.—Allis-Chalmers Sea Water Pump.

ROTARY PUMPS

There are various types and models of rotary pumps used in the aviation fuel system. It is not considered practical to describe all of them in this section; therefore, only the Blackmer (sliding vane) and the Viking (gear type) are discussed.

Blackmer

The Blackmer is the most commonly used rotary type pump in the aviation fuel system. (See fig. 9-16.) It may be used as either a transfer, stripping, or defueling pump. Each pump may vary slightly, but all are practically identical. A typical Blackmer is described here.

DESCRIPTION.—The Blackmer is a positive-displacement, rotary-vane type pump. It has three basic component parts—the cylinder and head assembly, the rotor and shaft assembly, and the pressure control valve.

Cylinder and Head Assembly.—The cylinder (pump casing) houses and provides a working area for the rotor and shaft assembly. (See fig. 9-17.) The cylinder is machined in a cam lathe to form an oval-shaped cylinder bore. The inlet and discharge ports are cast integrally with this section of the pump. The pressure control valve, located on top of the pump, is cast integrally with the upper portion of the cylinder bore. Each side of the cylinder has machined recesses to insure perfect installation of the cylinder heads.

The cylinder heads, one for each side of the pump, house the ball bearings and the mechanical seal assemblies. An O-ring is installed to prevent leakage of fluid at this point. (See fig. 9-18.)

The ball bearings, located in the bearing housing within each cylinder head, support the rotor and shaft assembly and insure the proper clearance between the rotor and upper position of the cylinder bore. A bearing cover, fitted with a grease fitting at the top and a grease relief fitting at the bottom, is bolted to the end of each cylinder head.

The mechanical seal assembly, installed in each head, prevents leakage of fluid along the shaft into the bearing housing. A telltale drain hole is provided on the underside of each head.

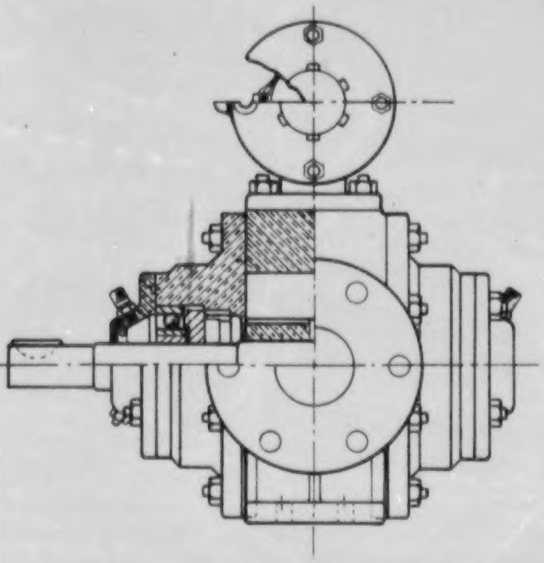

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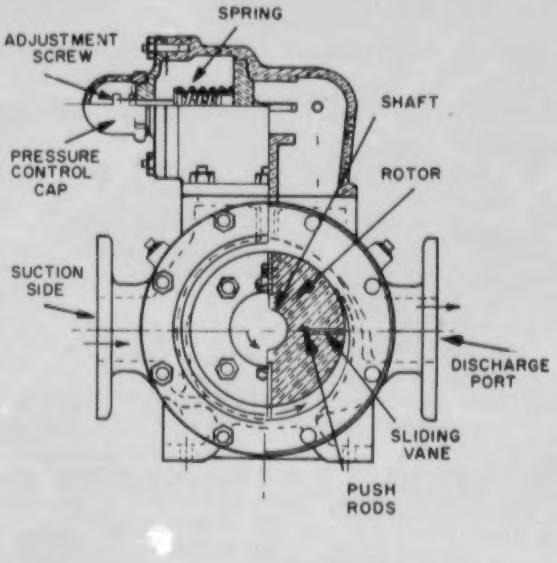
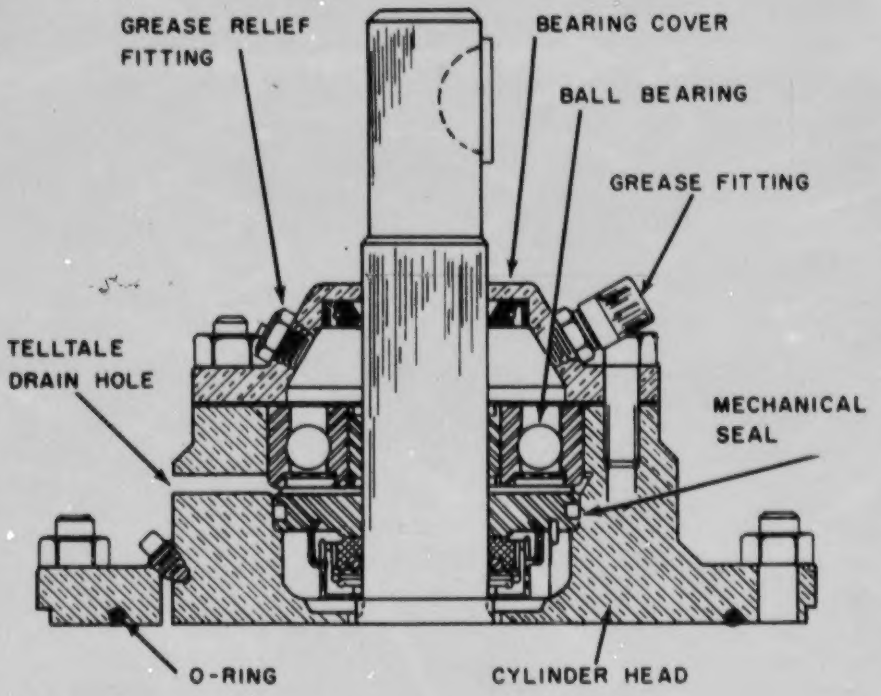
Figure 9-16.—Blackmer pump (end view).



198.91

Figure 9-17.—Blackmer pump (side view).



198.92

Figure 9-18.—Cylinder head (Blackmer pump).

These holes are located directly under the bearing housing. They are intended to serve as an indication of leakage at the mechanical seal assembly.

Rotor and Shaft Assembly.—The rotor and shaft is a pressed fit assembly held in place by tapered pins. The rotor is centered in the upper portion of the oval-shaped cylinder bore. The rotor has an even number of equally spaced slots. These slots provide the working area for the sliding vanes. Holes are drilled through the rotor and shaft, one between each set of opposing slots, for the installation and working area for push rods.

The sliding vanes are made of plastic. Relief grooves are provided on the forward face of the vanes to allow for the escape of liquid trapped between the vanes and the slots in the rotor.

NOTE: The vane must face the direction of rotation to allow the escape of fluids into the discharge port.

The shaft connects to the electric drive motor by an all metal flexible coupling and applies drive revolution to the rotor.

Pressure Control Valve.—The pressure control valve is provided to prevent buildup of excessive pressures that might damage the pump or associated equipment. It is spring-loaded to seat, and set by the adjustment screw to open at 50 psi, which directs the fluid from the discharge side to the suction side of the pump when overpressures occur. The adjustment screw has a locknut to lock it at the set pressure. The pressure control cap is screwed on the cover to protect the adjustment screw threads.

OPERATION.—The drive motor turns the shaft and rotor assembly. The rapid rotation of the rotor, therefore, forces the vanes in sliding contact with the cylinder bore by centrifugal force and push rods. The passage of vanes through the lower portion of the cylinder bore draws fluid into the pump, and at the same time, forces it out the discharge port. The pressure control valve maintains the desired or set pressure by limiting the pressure being discharged from the pump.

MAINTENANCE.–Lubricate the ball bearings periodically with a light ball bearing grease. Apply the grease slowly with a pressure gun until the grease begins to escape from the grease relief fitting. Do not attempt to over-grease. After lubrication, a small amount of grease may escape from the drain holes under the head. This is normal and proper, as the grease works past the sealed bearings for a short while after greasing. If grease continues to escape, the grease relief fitting should be removed and inspected for damage, or the bearing removed and its grease shield inspected for damage. If grease escapes from around the pump shaft, the bearing cover should be removed and the lip on the shaft seal inspected for nicks, cuts, or distortion (replace if necessary). The bearing cover should be installed, making sure the shaft seal is centered on the shaft while tightening cap screws.

Mechanical Seals.–The mechanical seals are normally expected to leak very slightly when newly installed, until worn in. The leakage appears at the drain holes under the bearing housing. If it becomes excessive, the mechanical seals should be replaced. Prior to installing the old O-rings, clean and apply a small amount of oil to them.

Head O-rings.–If leakage occurs between the head and the cylinder, the head should be removed and both machined faces inspected for burrs, dirt, cut O-ring, or other imperfections. If O-ring is cut or nicked, replace before reassembling.

Vanes.–If the vanes are excessively worn, or swelling or jamming in rotor slots, replace them.

Pressure Control Valve Adjustments.–Close the pump discharge valve; line up suction to a stowage tank. Start the pump, remove the cap, and loosen the locknut. Turn the adjustment screw until the desired pressure is indicated on the discharge pressure gage. Tighten the locknut, replace the cap, and stop the pump.

NOTE: When performing maintenance, refer to the appropriate pump technical manual and the applicable MRC's.

Viking Transfer Pump

DESCRIPTION.–The transfer pump made by the Viking Pump Co. (fig. 9-19) is an example of the internal gear type rotary pump. This pump has a capacity of 200 gpm at a total head of 50 psi with a suction lift of 8 inches Hg. The pump consists principally of a bracket, a head, a casing, and a casing liner; a bronze rotor, an idler, and a crescent; and a monel rotor shaft. The pump casing, with the casing liner, is attached directly to the bracket. The rotor, with rotor ring, is permanently pressed on the rotor shaft and is supported in the bracket by a ball bearing. The outer end of the shaft is supported by a ball bearing, which also positions the rotor lengthwise in the casing. The rotor drives the idler, which runs on the idler pin. The idler bushing is a press fit in the idler. The idler pin is installed in the head.

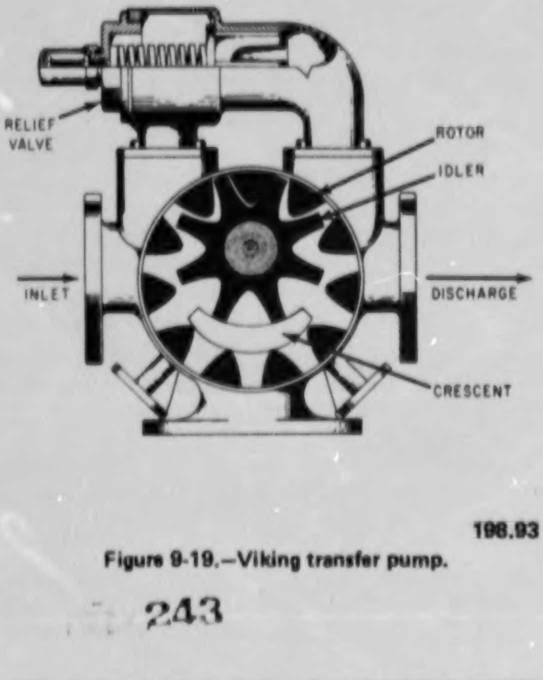


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Figure 9-19.–Viking transfer pump.

Rotation of the rotor gear causes the idler gear to rotate within the pump chamber. Also located in the pump chamber is the stationary crescent. As the gears rotate, the liquid is trapped between the crescent and the gears, forcing the liquid toward the discharge port; at this point, the gears mesh and discharge the liquid. The mechanical seal prevents liquid from escaping through the shaft end of the pump.

NOTE: On some internal gear pumps, the inner gear rather than the outer gear is attached to the pump shaft.

MAINTENANCE.—To properly troubleshoot pumps with an apparent malfunction, it is important that maintenance personnel understand the incorrect behavior of the equipment as related to performance, excessive heating, or leakage. Prior to any disassembly, the pump should be thoroughly examined for external evidences of defects. All evidence should be noted prior to maintenance. It is further recommended that the simplest or most obvious causes of trouble be explored before extensive maintenance is undertaken. The lubrication of both ball bearings is provided by packing the chamber between the bearings with grease. They should be repacked periodically in accordance with the MRC's for the pump. The idler bushing is automatically pressure-lubricated by the liquid pumped.

If at any time the pump has been disassembled, caution should be exercised in fitting rotor and head for proper clearance.

Clearance should be adjusted as follows. Loosen the two socket setscrews in the bearing housing, and turn the bearing housing clockwise, forcing the rotor against the head until the pump shaft can no longer be rotated by hand. When this happens, the rotor is dragging on the head and the clearance is zero. With pencil or chalk, make a reference mark on the bearing housing and the end of the bracket. Back off the bearing housing counterclockwise a little less than one hole (1/6 turn). One hole is equivalent to 0.014-inch end clearance. Tighten the two socket head setscrews. Care should be taken not to have excessive end clearance, as this prevents the pump from delivering full capacity.

Some internal gear pumps are equipped with internal type relief valves, as shown in figure 9-19.

The following instructions should be observed in changing the relief valve pressure setting, or in adjusting a reassembled valve.

Remove the adjusting screwcap, and loosen the locknut. The adjusting screw can now be turned in for increasing the pressure or turned out for decreasing the pressure. A pressure gage in the discharge line must be used to indicate the pressure setting. With the discharge line closed at a point beyond the pressure gage, the gage indicates the maximum pressure (approximately 75 psi) the relief valve allows while the pump is in operation. At this point the liquid is being completely bypassed through the relief valve.

PUMP COUPLINGS

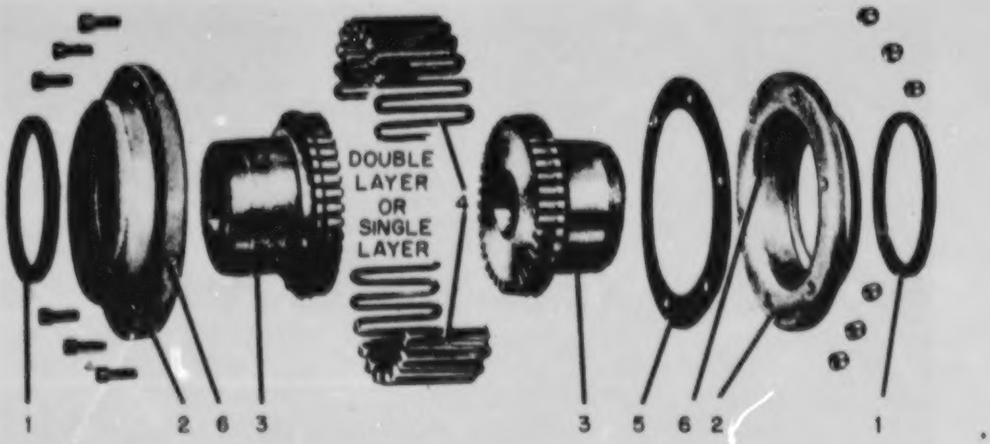
All aviation fuel pumps are equipped with a type of flexible coupling. This coupling allows connection with the pump and motor shafts. A minute amount of misalinement is allowed between the two shafts. This is extremely advantageous when removing the pump and motor for maintenance.

The flexibility of the coupling is normally gained from a gear, a spring arrangement, or a rubber insert in the housing between the coupling halves. The lubricant used may be grease or oil and, in some instances, no lubricant at all is used, depending on the type of coupling.

Falk Type F Steelflex Coupling

The coupling shown in figure 9-20 is a Falk flexible self-alining gridmember type. The two hubs are symmetrical, but may have different bores or keyways. One hub is keyed to the motor shaft, and the other is keyed to the pump shaft and secured axially by check nuts. The check nuts are held in place by sockethead setscrews. A flexible gridmember engages the teeth in the hubs to transmit power. A gasket and two seal rings are fitted to the covers to prevent grease leakage. The parts are enclosed in two cover halves which are bolted together.

MAINTENANCE.—When it is necessary to disconnect the coupling, remove the nuts and bolts, separate and draw back the cover halves,



1. Seal rings.
2. Cover halves.
3. Hubs.
4. Gridmembers.
5. Gasket.
6. Alemite grease fittings.

Figure 9-20.–Falk Type F Steelflex coupling. 198.94

and remove the gridmember. To remove the gridmember, a round rod or screwdriver that conveniently fits into the open loop ends of the gridmember is all that is required in the way of tools. Begin at the open end of the gridmember section and insert the rod or screwdriver into the loop ends. Use the teeth adjacent to each loop as a fulcrum, and pry the gridmember out radially in even, gradual stages. Proceed alternately from side to side lifting the gridmember about half way out until the end of the gridmember is reached. Using the same procedure once again, the gridmember clears the teeth. This allows the coupling hubs to become separated so the pump or motor shafts can be removed.

Prior to reassembly, clean all parts thoroughly and check the coupling alinement. To check the coupling alinement axially, measure the gap between the hubs with a feeler gage at four points, 90 degrees apart. The gap should be approximately 1/8 inch and the distance between the maximum and minimum measurements should not vary more than 0.003 inch.

To check the coupling alinement radially, place a straightedge on the teeth of the hubs. The clearance between the straightedge held firmly on the teeth of one coupling hub and the teeth of the other coupling hub should not be more than 0.003 inch as measured with a feeler gage. Repeat this check at a point 90 degrees from the first check.

After the coupling is alined, carefully insert the gasket between the hubs and hang it on either hub. Do not damage the gasket. Next, force as much lubricant as possible into the space between the hubs and gridmember grooves.

Insert the gridmembers. To accomplish this with a minimum amount of spreading, start the gridmember at either end and tap the rungs only part way into the grooves. After all the rungs are partially in their respective grooves, tap the gridmember all the way into place. The hub grooves are uniformly spaced and do not require matching. Again pack lubricant in the spaces between and around the gridmember with as much lubricant as possible, then wipe off excess flush with the top of the gridmember. Lightly oil the hubs to facilitate the sliding of the covers onto the hubs. Mount the covers so that the lubrication fittings are 180 degrees apart. Insert a screwdriver under the seal ring for venting purposes and then tighten the cover bolts. Check the seal rings for proper seating, and aline the cover to prevent wobble.

Periodic lubrication is essential for proper functioning of the coupling. Alemite grease fittings are provided for convenient lubrication. The design of the Alemite lubrication fittings prevent leakage due to centrifugal force. When lubricating the coupling, vent as described above.

Lovejoy Coupling

The Lovejoy coupling (fig. 9-21) mechanically links the shaft of the pump to the shaft of the motor. The coupling is made of two bronze coupling halves. The coupling is keyed to the shaft and held in place by socket-head setscrews. The coupling halves are cushioned by a formed rubber spider which separates the coupling halves. This rubber separation also serves to reduce the noise of the coupling.

MAINTENANCE.–When the reassembling of any component of the pump unit involves recoupling, the coupling should be checked for misalinement. This should be done using a straightedge and a feeler gage. If the couplings are not properly alined, the base may have been distorted or warped. This distortion must be corrected and is accomplished by loosening the anchor bolts and shimming under the base.

When making an adjustment of the couplings, insure that each section of the coupling is tightly anchored to its respective shaft and that both sections are butted together with 1/8-inch space between the coupling sections and the rubber spider.

NOTE: This coupling requires no lubrication.

AIRCRAFT FUELING STATIONS

There are currently four fueling units in the fleet. They are the Wayne, Blackmer, Wheeler, and the Cla-Val units. However, since the Wayne and Wheeler units are not widely used, only the Blackmer and Cla-Val are discussed here. The Blackmer units are used on the CVA-42, 59, 60, and 61. The Cla-Val station is the most widely used of the four. It is being used on the CVA-34, 43, 63 and all CVA's constructed thereafter. It is also used on all LPD's and all LPH class 2 carriers.

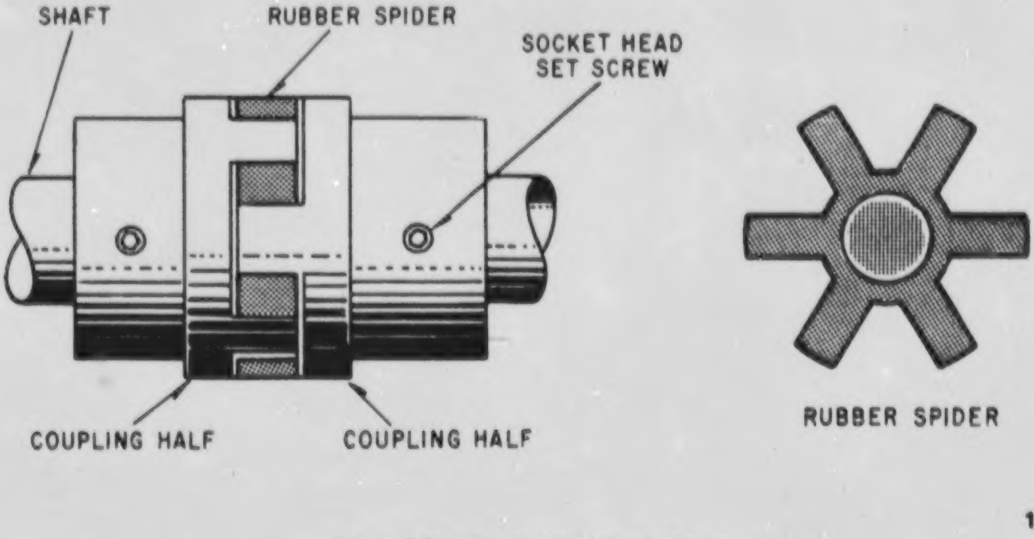


Figure 9-21.–Lovejoy flexible coupling.

Blackmer

The Blackmer service station is a twin pumping unit consisting of—two centrifugal pumps in a single housing, two semiautomatic four-way valves, and two magnetic amplifiers.

Each centrifugal pump is designed to deliver 200 gpm at 40 psi (as long as riser pressure is maintained at 5 psi minimum) to aircraft equipped for underwing fueling. Each pump defuels up to 100 gpm as long as the riser pressure does not exceed 20 psi.

The cast steel casing is divided into four compartments by the impeller adapters. (See fig. 9-22.) Single-suction impellers, keyed to the shaft and secured with a locknut, are located in the two center compartments. Leakage between the two center chambers is prevented by two mechanical seals, one in each discharge chamber. A third mechanical seal, located in the suction compartment nearest the meter, prevents leakage of fuel from around the shaft where it passes through the casing.

Blackmer four-way valves contain four valves in their housings. (See fig. 9-23.) A single-port suction return valve, a double-port discharge valve, and a single-port suction valve operate together. A poppet restriction valve operates independently of the other three. The four-way valve is manually placed in its fueling position

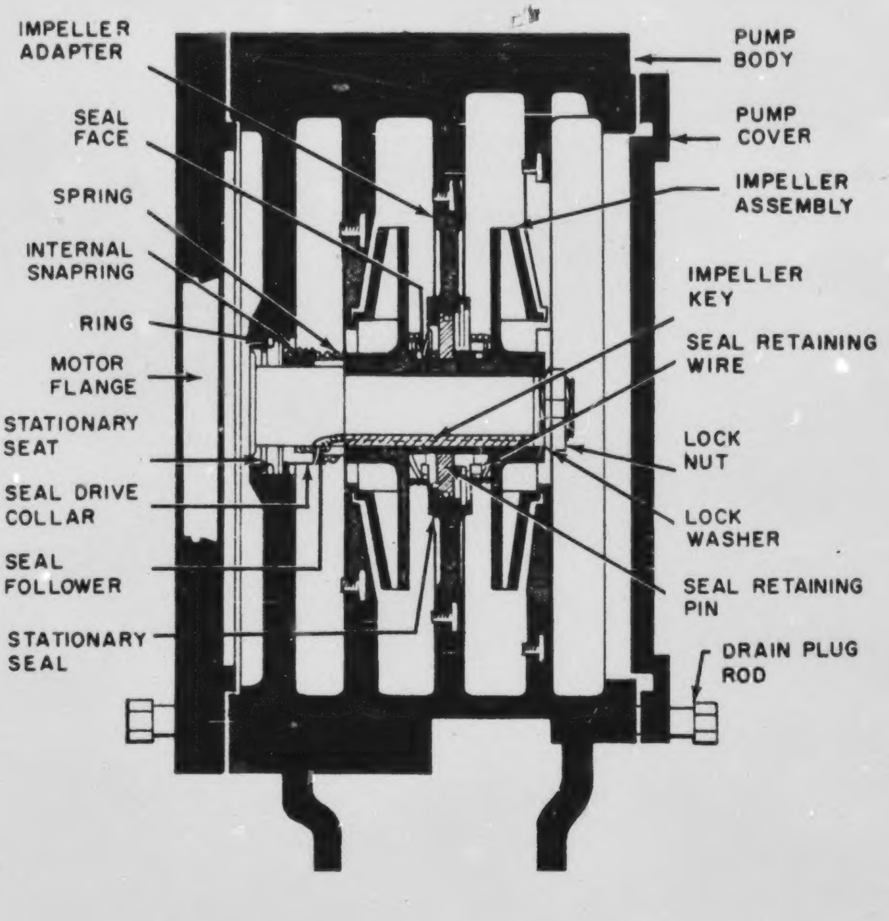

IMPELLER ADAPTER
SEAL FACE
SPRING
INTERNAL SNAPRING
RING
MOTOR FLANGE
STATIONARY SEAT
SEAL DRIVE COLLAR
SEAL FOLLOWER
STATIONARY SEAL
PUMP BODY
PUMP COVER
IMPELLER ASSEMBLY
IMPELLER KEY
SEAL RETAINING WIRE
LOCK NUT
LOCK WASHER
SEAL RETAINING PIN
DRAIN PLUG ROD

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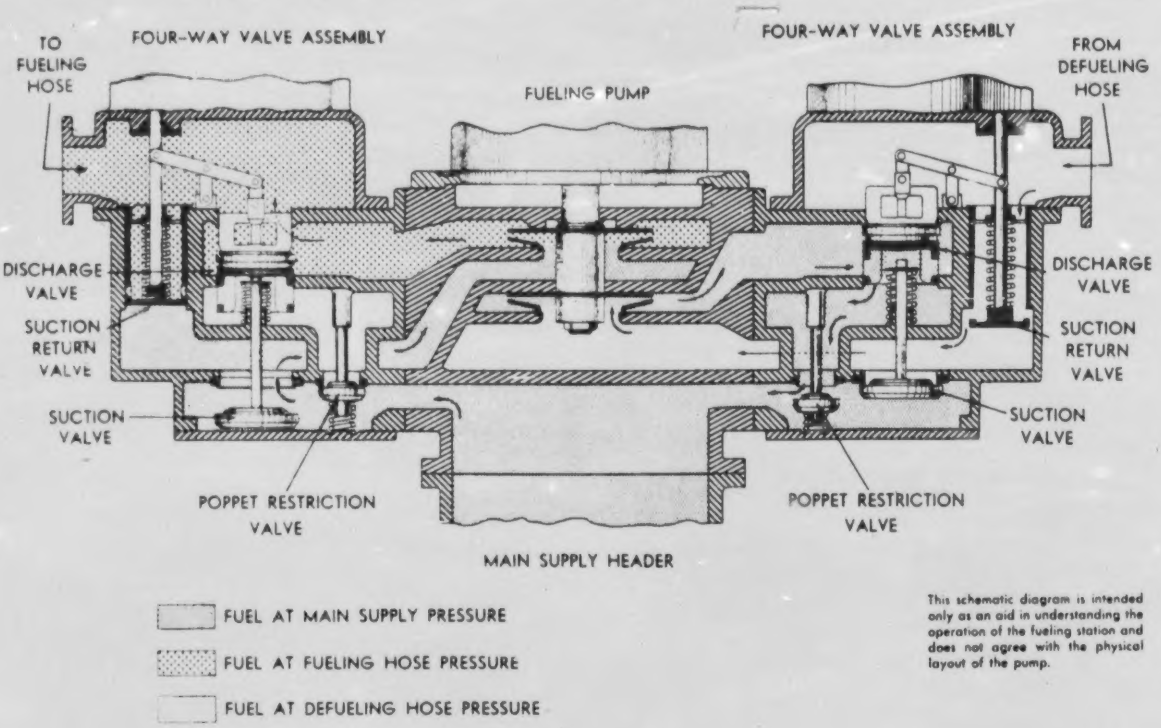
Figure 9-22.—Blackmer fueling pump.


TO FUELING HOSE
FOUR-WAY VALVE ASSEMBLY
FOUR-WAY VALVE ASSEMBLY
FROM DEFUELING HOSE
FUELING PUMP
DISCHARGE VALVE
DISCHARGE VALVE
SUCTION RETURN VALVE
SUCTION RETURN VALVE
SUCTION VALVE
SUCTION VALVE
POPPET RESTRICTION VALVE
POPPET RESTRICTION VALVE
MAIN SUPPLY HEADER
FUEL AT MAIN SUPPLY PRESSURE
FUEL AT FUELING HOSE PRESSURE
FUEL AT DEFUELING HOSE PRESSURE

This schematic diagram is intended only as an aid in understanding the operation of the fueling station and does not agree with the physical layout of the pump.

198.97

Figure 9-23.—Fueling pump and four-way valves flow diagram.

(when the solenoid is energized) by lifting the operating handle 90 degrees. The handle shaft pinion is geared to the suction return valve stem. Raising the handle 90 degrees rotates the pinion, lifts and closes the suction return valve, and compresses the suction valve spring. The discharge valve is linked to the suction return valve spring in such a way that raising the suction return valve lowers the discharge valve. When the discharge valve is lowered, it strikes the suction valve stem, opens the suction valve, and compresses the suction valve spring. The handle shaft pinion is held in the fueling position by a locking pawl as long as the solenoid remains energized. The solenoid housing serves as a cover for the four-way valve body and contains the solenoid, the pawl assembly, and the shaft pinion. Four-way valves are returned to the defuel position by their suction and suction return valve springs, when the solenoid is deenergized. Deenergizing the solenoid causes the pawl to release the shaft pinion. When the shaft pinion is released, the suction return valve spring expands, moves the suction return valve down to open, raises the discharge valve to close off the pump discharge to the hose reel and opens the pump discharge to the poppet restriction valve. When the discharge valve moves up, the suction valve spring expands, closing the suction valve. The poppet restriction valve is held closed by a spring and by the riser pressure. The poppet restriction valve is opened by the pump impeller pressure when the four-way valve is in defuel.

Each four-way valve has its own magnetic amplifier. The function of the amplifier is to provide enough power to energize the solenoid and hold the valves in the fueling position with a control circuit current sufficiently low to eliminate any danger of sparking. When the ground circuit through the delivery hose is closed the amplifier energizes the solenoid sufficiently to provide enough thrust force on the pawl to latch the valves in position. When this control circuit is opened the amplifier output drops off to the point where the solenoid thrust is no longer sufficient to hold the pawl in position.

One hose reel on each Blackmer station is adapted for a 1½-inch hard rubber hose and one hose reel for a 2½-inch collapsible hose.

NOTE: When troubleshooting or performing maintenance on Blackmer units, refer to the Blackmer Instruction Book and the applicable Maintenance Requirements Cards.

CLA-VAL

The Cla-Val fueling station consists of two or more solenoid-operated fuel-defuel valves and a positive-displacement defueling pump.

This installation eliminated venturi controls in each JP-5 quadrant. Pressure regulation is incorporated in the automatic fuel-defuel valves.

The defueling pump has a rated capacity of 100 gpm at 15 psi. Discharge from this pump is directed to an independent defueling main. From the defueling main, fuel flows to the transfer main and to a selected stowage tank.

The automatic fueling and defueling valve is intended for use as an integral part of the aviation gasoline and JP-5 fuel dispensing systems aboard ship. This valve performs four distinct functions:

1. It functions as a pressure-reducing valve to maintain a constant discharge pressure.
2. It functions as a solenoid-operated emergency shutoff valve.
3. It functions as a pressure relief valve whenever discharge pressure rises above a predetermined setting.
4. It functions as a defueling valve to evacuate the piping system beyond the valve discharge.

To perform the functions outlined above, two valves are fabricated into one body. During normal fueling operation, the defueling valve is closed and the fueling valve functions as a pressure-reducing valve to maintain a constant delivery pressure. If the pressure on the downstream side rises above the setting of the pressure-reducing valve, the defueling valve opens to serve as a pressure relief valve.

During defueling operation, the fueling valve is closed and the defueling valve is open. When the solenoid pilot valve is deenergized, the fueling valve closes to provide positive shutoff of the fueling line and simultaneously the defueling valve opens.

Description.–The main valve consists of two single-seated globe valves built into a single body (fig. 9-24). Each globe valve employs a well-supported and reinforced diaphragm as its operating means. The fueling valve is spring loaded to close and is, therefore, normally closed. The defueling valve is normally held open by its own weight.

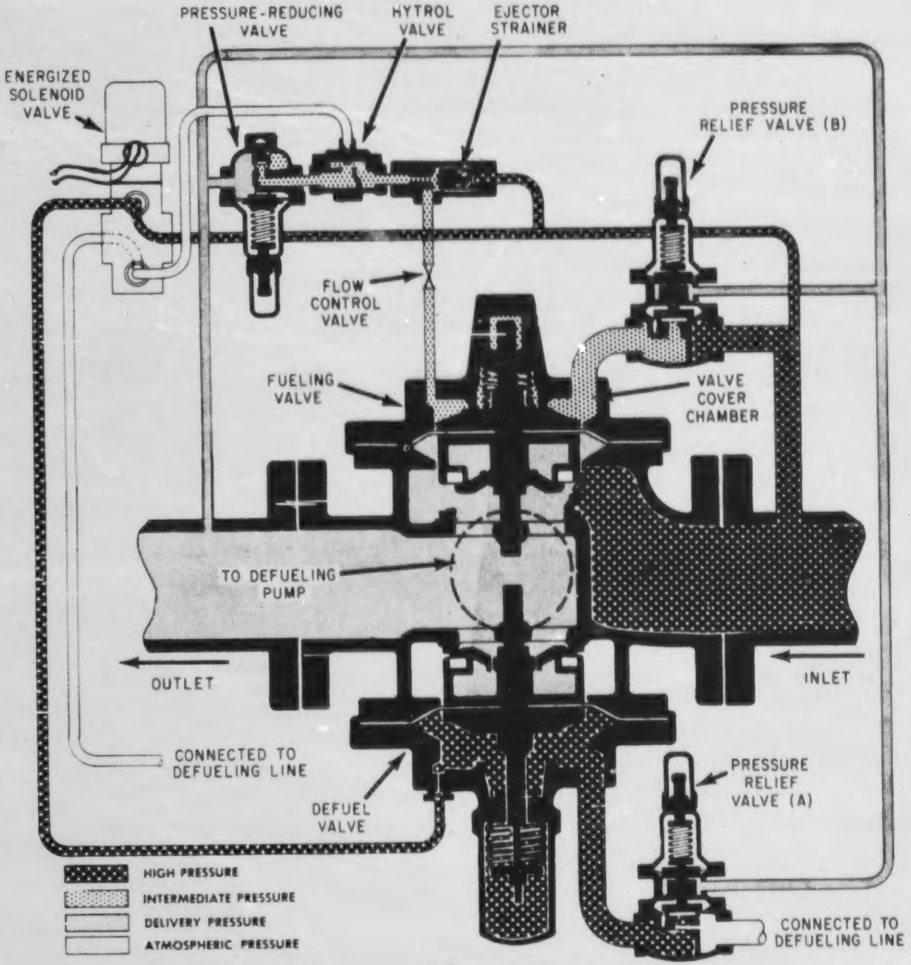
The pilot valve system utilizes line pressure to control the main valve, thus providing fully automatic operation. When the line pressure is admitted to the valve cover chamber, the force thus developed closes the valve. When the pressure in the cover chamber is released, the line pressure at the valve seat forces the valve open.

In the event of diaphragm failure, the fueling valve closes drip-tight and the defueling valve opens wide.

The pressure relief valves automatically open to permit flow whenever the controlling pressure under the diaphragm exceeds the force of the compression spring. They were designed primarily as pilot valves to control the operation of the main valves; thus, they operate within very close pressure limits.

These are direct-acting spring-loaded valves designed with a large diaphragm working area in relation to the valve seat area, to insure positive operation. They are held closed by the force of the compression spring. Pressure on the spring is adjusted by rotating the adjusting screw to vary spring compression on the diaphragm. Compressing this spring increases the pressure at which the valve opens. The spring can be adjusted to provide a relief setting from 20 to 70 psi. The adjusting screw is protected by a bronze housing drilled to accommodate a lead seal wire.

The pressure relief control is normally held closed by the force of the compression spring. When the controlling pressure under the


PRESSURE-REDUCING VALVE
HYTROL VALVE
EJECTOR STRAINER
ENERGIZED SOLENOID VALVE
PRESSURE RELIEF VALVE (B)
FLOW CONTROL VALVE
FUELING VALVE
VALVE COVER CHAMBER
TO DEFUELING PUMP
OUTLET
INLET
CONNECTED TO DEFUELING LINE
DEFUEL VALVE
PRESSURE RELIEF VALVE (A)
CONNECTED TO DEFUELING LINE
HIGH PRESSURE
INTERMEDIATE PRESSURE
DELIVERY PRESSURE
ATMOSPHERIC PRESSURE

197.33.1

Figure 9-24.—Cla-Val fuel defuel valve (fuel position).

diaphragm exceeds the set spring force, the disk is lifted off the seat, permitting flow.

The pressure-reducing control system automatically reduces a higher initial pressure to a steady reduced pressure. It was designed primarily as a pilot valve to control the operation of diaphragm-type main valves; thus, it operates within very close pressure limits.

It is a direct-acting, spring-loaded valve designed with a large diaphragm working area in relation to the valve seat, which insures sensitive control and accurate regulation of the delivery pressure. Pressure adjustments are made by rotating the adjusting screw to vary spring compression on the diaphragm. Compressing this spring increases the delivery pressure setting. The spring can be adjusted to provide delivery from 15 to 100 psi. The adjusting screw is protected by a bronze housing, drilled to accommodate a lead seal wire.

The pressure-reducing control valve is normally held open by the force of the compression spring. When the delivery pressure acting upon the lower side of the diaphragm exceeds the force of the compression spring, the control closes. Conversely, when the delivery pressure reduces below the spring setting, the control valve opens. Thus, a constant delivery pressure is maintained by balancing the delivery pressure against the spring pressure.

The flow control valve controls operation of the fuel valve to prevent valve slam and charging of the fueling hose too quickly.

The hytrol valve is of the modified globe design, employing a well supported and reinforced diaphragm as the operating means. When the line pressure is admitted to the cover chamber, the force thus developed closes the valve. When the pressure in the cover chamber is released, the line pressure at the valve seat forces the valve to a wide open position.

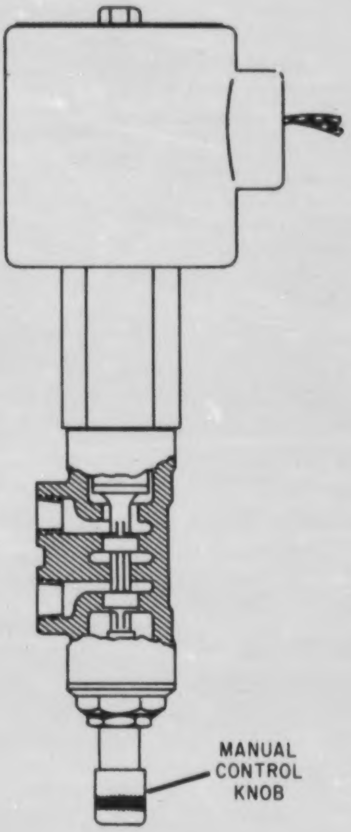
The ejector-strainer consists of a primary and a secondary jet screwed into a cast bronze housing. The jets are protected from clogging by a 60-mesh monel screen. Both jets can be removed for cleaning. Flow through the ejector-strainer creates a reduced pressure area between the primary jets and the secondary jets.

The solenoid pilot valve (fig. 9-25) is a direct-acting, piston type, solenoid-actuated valve. The piston is drawn upward by the action of the solenoid when energized, and the piston is returned to the down position under the influence of gravity and a spring when the solenoid is deenergized. The valve disks on the piston are lapped into the bore in the valve body. This valve has full pipe-size port areas and the piston moves from full flow in one direction to full flow in the opposite direction—there is no closed port position. The valve is also equipped for manual operation. Manual operation is accomplished by pushing upward on the knob at the lower end of the control valve. A quarter-turn clockwise locks the manual control in place.

OPERATION.—To understand the operation of the Cla-Val fuel/defuel valve, it is essential to be familiar with the following:

1. This valve is really two separate and distinct valves, both sharing a common body.

2. Each of these valves performs a separate and distinct function, one valve being the fueling valve and the other being the defueling valve.



198.122

Figure 9-25.—Solenoid operated pilot valve (cutaway).

3. Although both of these valves are separate and distinct from each other, they work closely in conjunction with one another and they both share a common pilot valve system.

4. The change from the fueling operation to the defueling operation is accomplished by positioning the solenoid pilot valve. A step-by-step analysis of the valve's operation follows.

Figure 9-24 illustrates the valve in the fueling position with the solenoid energized.

The solenoid valve directs high pressure from the main valve inlet into the cover chamber of the defueling valve, holding it closed.

The solenoid valve also vents the cover chamber of the hytrol valve to the defueling line. This opens the hytrol valve, which permits the pressure-reducing valve to take over control of the fueling valve.

When the pressure-reducing pilot valve goes into operation, the high-pressure fuel enters the fueling valve and bypasses through the ejector-strainer to the pilot valve, which is held open by the pilot valve spring. With pressure at the pilot valve below the adjusted setting, maximum flow is permitted through the ejector-strainer, thus creating a reduced pressure in the main valve cover chamber which allows the valve to open to build up pressure in the downstream system. The increasing downstream pressure is transmitted through the pilot control line to the underside of the pilot valve diaphragm.

When the pressure under the pilot valve diaphragm reaches a point where it balances the loading of the pilot valve spring, the pilot valve begins to close, thus restricting the flow through the ejector-strainer sufficiently to increase the pressure in the main valve cover chamber. The resulting increase in pressure in the cover chamber forces the disk toward the seat until the main valve is passing just enough fuel to maintain a downstream pressure that balances the loading of the pilot valve springs.

Any subsequent change in fuel demand will tend to cause a slight change in downstream pressure, which will result in the pilot and main valve assuming new positions to supply the new demand.

As long as the normal fueling operation is in process and the flow rate is not changing very rapidly, the fueling valve functions as outlined above. If the flow rate suddenly decreases, two things happen—(1) any pressure rise is offset by the opening of the defueling valve, and (2) the fueling valve closes rapidly.

Figure 9-24 shows that the delivery pressure is reflected under the diaphragm of both pressure relief valves, opposing the force applied by the spring.

When a downstream pressure rise occurs which is sufficiently high to overcome the force of the spring, pressure relief valve (A) opens to relieve the pressure from the cover of the defueling valve. This allows the defueling valve to open, thereby relieving the excess pressure into the defueling line.

The purpose of pressure relief valve (B) is to increase the closing speed of the fueling valve. When there is a sudden rise in the delivery pressure, this valve opens and admits the upstream line pressure into the fueling valve cover chamber to rapidly close it.

When the pressure and the flow conditions return to normal, the valve resumes its normal function.

Figure 9-26 illustrates the valve in the defueling position. The solenoid is deenergized.

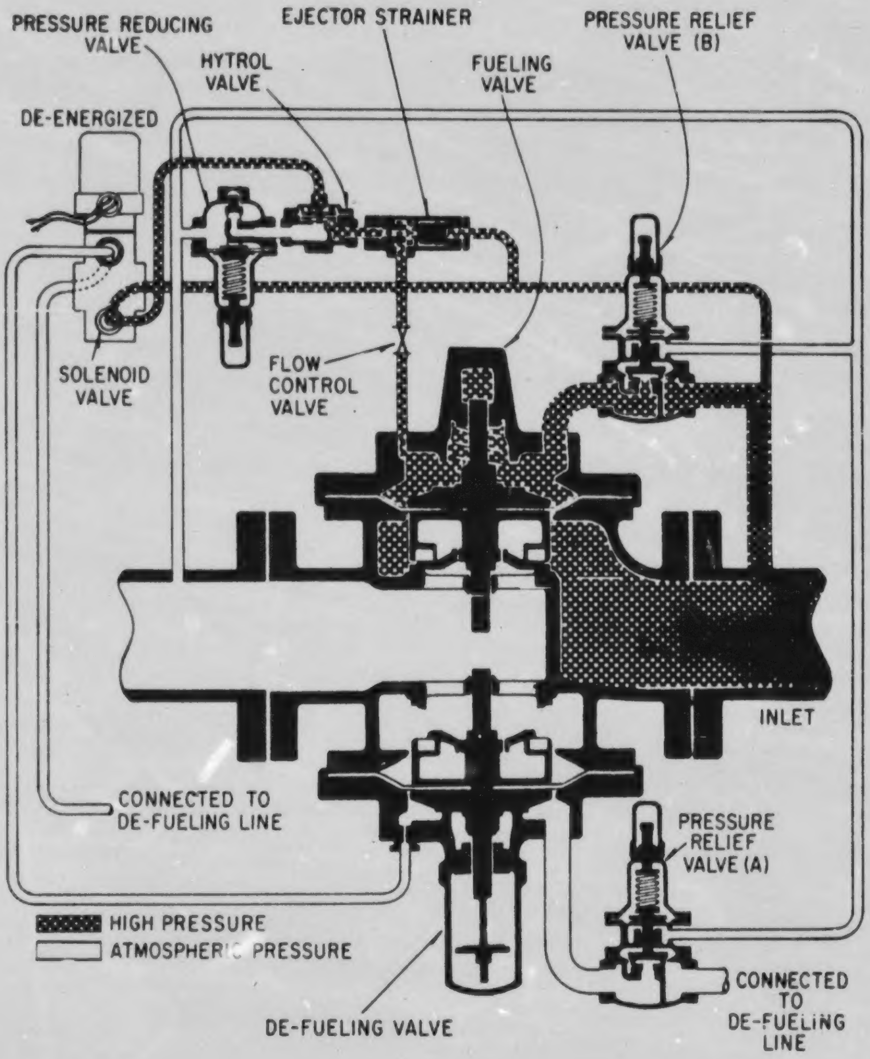
The solenoid valve directs the high pressure from the main valve inlet into the cover chamber of the hytrol valve, holding it closed. This diverts high pressure through the ejector-strainer into the cover chamber of the fueling valve, holding it closed.

The solenoid valve also vents the cover chamber of the defueling valve to the defueling line. With pressure released from this cover chamber, the valve falls open.

INSTALLATION INSTRUCTIONS.—The following instructions should be carefully followed when installing the valve:

1. Flush all piping thoroughly to remove chips, scale, or other foreign matter.
2. Exercise care in the handling of the valve to prevent damage to any of the tube lines or controls. The valve is air-tested at the factory and any jarring or wrenching of any of the components of the valve may cause leakage to occur.
3. Install the valve in the horizontal run of the piping in accordance with the nameplate markings on top of the inlet flange.
4. Insure that the electrical connection to the solenoid pilot valve is in accordance with accepted shipboard practice.

PRESSURE SETTINGS.—The following steps refer to setting the Cla-Val fuel/defuel valve for a final delivery pressure of 30 psi. (If a delivery pressure other than 30 psi is desired, the procedures remain the same—only the pressures will vary).


PRESSURE REDUCING VALVE
EJECTOR STRAINER
PRESSURE RELIEF VALVE (B)
HYTROL VALVE
FUELING VALVE
DE-ENERGIZED
SOLENOID VALVE
FLOW CONTROL VALVE
INLET
CONNECTED TO DE-FUELING LINE
PRESSURE RELIEF VALVE (A)
▨ HIGH PRESSURE
☐ ATMOSPHERIC PRESSURE
CONNECTED TO DE-FUELING LINE
DE-FUELING VALVE

197.33.2

Figure 9-26.—Cla-Val fuel/defuel valve (defuel position).

NOTE: A pressure gage must be installed in the line between the fuel/defuel valve and the hose.

1. Remove the adjusting screw housings on both pressure relief valves, and the pressure-reducing valve.

2. Loosen the jam nuts and bottom the adjusting screws on both pressure relief valves.

3. Line up the service system piping and pressurize the quadrant.

4. Unreel the hose and connect the nozzle to the defueling main.

5. Using the proper grounding procedures, start the defueling pump.

6. Position the toggle switch to the "ON" position.

7. Turn the adjusting screw of the pressure-reducing valve slowly until the gage in the delivery line reads 10 psi higher than the desired pressure (40 psi in the case of this example).

8. Tighten the jam nut to lock the adjusting screw.

9. Turn the adjusting screw of the defuel pressure relief valve slowly until the delivery pressure gage dips downward (approximately 2½ psi).

10. Tighten the jam nut to lock the adjusting screw.

NOTE: The defuel pressure relief valve is set 7½ psi higher than the delivery pressure.

11. Back off the jam nut and slowly turn the adjusting screw of the pressure reducing valve until the delivery pressure drops to a point 5 psi above the desired setting (35 psi in the case of this example).

12. Tighten the jam nut.

13. Turn the adjusting screw of the fuel valve's pressure relief valve slowly until the delivery pressure gage begins to dip downward (approximately 2½ psi).

14. Tighten the jam nut to lock the adjusting screw.

15. Turn the adjusting screw of the pressure-reducing valve slowly until the delivery pressure has dropped to the desired setting (30 psi in the case of this example).

16. Tighten the jam nut to lock the adjusting screw.

17. Replace the adjusting screw housings, and insert the lead seal wires.

For more detailed information on the operation, maintenance, and troubleshooting procedures of the automatic fueling and defueling valve, consult the NAVSHIPS Technical Manual 0348-135-1000.

AUTOMATIC PRESSURE REGULATOR

The pressure-regulating system (fig. 9-27) is identical on all class carriers, except for size and pressure settings. An automatic pressure-regulating system is provided to maintain a constant pressure under all conditions of operation or load.

NOTE: The automatic pressure regulator system is not needed when using the Cla-Val type fueling stations.

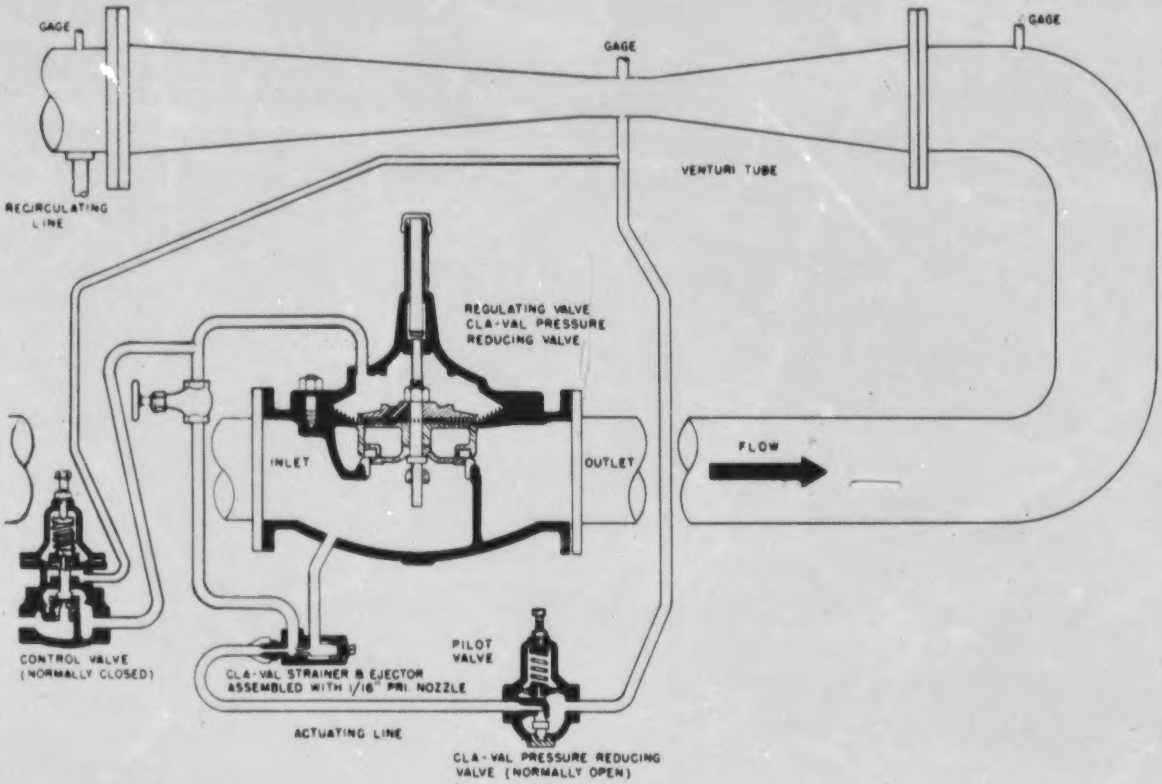
The system consists of an automatic pressure-regulating valve actuated through changes of pressure in the throat of a venturi, located downstream of the valve. The components of the regulating system are—the main valve (pressure regulator), the pilot valve, the ejector strainer assembly, the control valve, and the venturi tube.

The pressure-regulating system is entirely hydraulic in operation, utilizing line pressure to open and close the valve. Because it is hydraulic in operation, it is installed either vertically or horizontally in the riser.

The main valve is of a modified globe design, employing a well-supported and reinforced diaphragm. It is hydraulically operated. When line pressure is admitted to the cover chamber, the valve tends to close. When the pressure is reduced in the cover chamber, the line pressure under the disk opens the valve.

The pilot valve is a direct-acting, spring-loaded valve, designed with a large diaphragm and effective working area to insure sensitive control and accurate regulation of the required delivery pressure. The pilot valve is located in the actuating line between the ejector strainer and the venturi throat. It is normally held open by a compression spring. When the venturi throat pressure acting under the diaphragm increases, the valve tends to close. When the venturi throat pressure decreases, the valve opens (wider). Thus, a constant pressure is maintained by balancing the venturi throat pressure against the spring tension.

The control valve (ejector bypass valve) is a direct-acting, spring-loaded valve designed with a large diaphragm and effective working area to insure positive operation. The control valve, located in the ejector bypass line, is normally held closed by a compression spring. Its purpose is to close the main valve quickly when there is a sudden buildup in the downstream pressure. It is opened by venturi throat pressure 10 psi in excess of the pilot valve setting.


GAGE
GAGE
GAGE
RECIRCULATING LINE
VENTURI TUBE
REGULATING VALVE CLA-VAL PRESSURE REDUCING VALVE
INLET
OUTLET
FLOW
CONTROL VALVE (NORMALLY CLOSED)
PILOT VALVE
CLA-VAL STRAINER & EJECTOR ASSEMBLED WITH 1/16" PRI. NOZZLE
ACTUATING LINE
CLA-VAL PRESSURE REDUCING VALVE (NORMALLY OPEN)

198.98

Figure 9-27.–Automatic pressure regulator.

The ejector strainer assembly is installed in the actuating line between the main valve and the pilot valve. It consists of an ejector nozzle with a 1/16-inch orifice and a monel strainer to prevent clogging of the nozzle. It speeds up the operation of the main valve by speeding up the evacuation of fluids from the cover chamber. It prevents chatter of the main valve by reducing the violence with which the pump discharge pressure is admitted to the main valve cover chamber.

Venturi tubes are installed in each quadrant distribution riser downstream of the regulating valve. The venturi (interim) tapers from a 6-inch inlet to a 2.9-inch throat to a 6-inch outlet. A recirculating line on the delivery side returns 100 gpm to the service tank in use. This recirculation maintains a regulated pressure, by allowing a flow through the regulator during standby periods, and provides a means of returning to the tank the fuel from the last hose to be defueled when the system is pressurized.

NOTE: If a fluid flowing through a tube reaches a constriction or narrowing of the tube, the speed of the fluid flowing through the constriction increases, and its pressure decreases. If the fluid flows into a tube of the same size as that of the original, speed decreases and pressure increases.

OPERATION

In the operation of the system, the high-pressure fuel from the pump enters the main valve body. This fuel bypasses the main valve seat and flows through the ejector strainer assembly to the pilot valve. The pilot valve is held open by its spring. From the pilot valve, fuel flow is directed into the throat of the venturi tube. Thus far, the pressure at the throat of the venturi tube is practically nonexistent.

As long as the pilot valve stays open, maximum flow through the ejector-strainer assembly is permitted. This fuel flow through the ejector-strainer assembly creates a reduced pressure in the main valve cover chamber. (It must be remembered that the ejector-strainer assembly works like an eductor.) Line pressure from the pump, working under the disk of the main valve, now opens the main valve, permitting fuel flow into the quadrant distribution riser. This fuel flow builds up pressure in the quadrant distribution riser.

The increasing pressure in the riser is transmitted from the throat of the venturi tube to the underside of the pilot valve diaphragm. When the pressure under the pilot valve diaphragm reaches a point where it is greater than the setting of the pilot valve spring, the pilot valve begins to close. This restricts the fuel flow through the ejector-strainer assembly.

With the fuel flow restricted, the ejector-strainer assembly loses its suction and the inlet pressure is diverted, via the suction line, to the main valve cover chamber.

The resultant increase in pressure in the main valve cover chamber, as applied to its diaphragm, is sufficient to begin closing the main valve. The main valve disk moves toward its seat until the main valve is passing just enough fuel to maintain a pressure that balances the setting of the pilot valve via the throat of the venturi.

Any subsequent change in fuel demand causes a change in venturi throat pressure. Even the slightest change is sufficient to cause the pilot valve and the main valve to assume new positions to supply the new demand. This happens, regardless of whether the demand is for a greater or lesser amount of fuel.

An increase in the rate of fuel flow, caused by putting additional hoses into operation, at first causes a momentary decrease in venturi throat pressure. This decrease in pressure allows the pilot valve to open wider, which in turn increases the fuel flow rate through the ejector-strainer assembly.

An increase in ejector-strainer assembly flow rate increases the suction lift of the ejector. The increase of the suction lift is applied to the main valve cover chamber and allows the main valve to open wider.

The main valve opens in proportion to the increase of flow demand topside. The main valve continues to open until the venturi throat pressure builds up to a point where it again balances the setting of the pilot valve.

A decrease in flow rate, caused by securing hoses topside, causes a momentary increase in venturi throat pressure. This increase in pressure causes the pilot valve to close somewhat, restricting the fuel flow through the ejector-strainer assembly.

A decrease in flow through the ejector-strainer decreases the suction lift of the ejector. This decrease of ejector suction lift causes an increase of pressure in the main valve cover chamber and results in partial closing of the main valve.

The main valve closes in proportion to the decrease of the flow demand topside. The main valve continues to close until the venturi throat pressure drops to a point where it again balances the setting of the pilot valve spring.

Any sudden demand decrease in the flow rate, caused by the securing of all hoses topside or for any other reason, creates a sudden high increase in the venturi throat pressure. This sudden increase of pressure is applied to the underside of the diaphragm of the pilot valve to close the main valve in the normal manner. Because of the small size of the orifice in the ejector-strainer (1/16-inch diameter), the main valve closes slowly. At the same time, venturi throat pressure is applied to the underside of the diaphragm of the control valve and opens the control valve. When the control valve opens, full pump discharge pressure is applied to the main valve cover chamber to quickly close the main valve. This quick closing of the main valve reduces the pressure in the quadrant distribution riser. The main valve remains closed until the pressure on the discharge side of the main valve drops below the spring setting of the pilot valve. The pressure and fuel that are trapped between the discharge side of the main valve and the discharge side of the venturi, caused by a sudden buildup of discharge pressure, are relieved through the venturi recirculating line back to the drawoff tank or service tank, as the case may be.

MAINTENANCE

The ejector strainer assembly should be cleaned at regular intervals. Remove the ¾-inch union ring and plug from the housing and wash in solvent, then blow the screen out with air. At 6-month intervals, the regulating valve should be completely dismantled and thoroughly cleaned. (See applicable MRC.) The pilot valve and control valve should be inspected carefully for excessive wear, and replaced if necessary. All gages used in the pressure regulating valve system are removed, cleaned, and calibrated every 6 months. Upon installation of new parts or repairs made on parts, all piping connections are pressure tested to check for leakage of fuel.

ADJUSTMENT AND SETTINGS

The pilot valve pressure adjustment is made by rotating the adjusting screw to vary spring compression on the diaphragm. The control valve adjustment is made by turning the adjusting screw clockwise to increase the pressure. The procedure for adjusting the pressure settings is:

NOTE: The following procedure should be followed after reinstallation of the regulating valve and pilot assembly after the maintenance check has been performed.

EXAMPLE: The desired delivery pressure is 22 psi at the throat of the venturi.

Close the control valve by turning the adjusting screw clockwise. Set the regulator (pilot valve) at 34 psi when the fuel is flowing through the main valve at a rate of 50 gpm or more. Reduce the pressure setting of the control valve (by turning the adjusting screw counterclockwise) until delivery pressure drops to 32 psi at the throat of the venturi. Tighten the control valve locknut. Reset the regulator (pilot valve) at 22 psi. The procedure outlined above establishes the desired downstream pressure and also provides the correct setting of the control valve.

CHAPTER 10

ADMINISTRATION

The administration of a division never stops at the division officer level. Senior ABF's should be aware of this fact. Administration of a division entails many records to be kept and reports to be filed. It is necessary to maintain accurate and up-to-date records on all equipment, as well as inventories of materials on hand.

Senior ABF's should be familiar with supply procedures in order to procure and maintain equipment for the fuel systems in accordance with current directives. They must also be familiar with the publications used in identifying material, equipment, and spare parts, as well as the publications used in maintaining equipment.

This chapter deals with some of these administrative problems, beginning with a section on technical publications.

TECHNICAL PUBLICATIONS

Technical publications are the sources of information for guiding naval personnel in the operation and maintenance of all equipment within the Naval Establishment. By proper use of these publications, all equipments can be operated and maintained efficiently and uniformly throughout the Navy.

Senior petty officers must be able to interpret and supervise the use of publications. The ABF1 and ABFC must also know how to procure publications and keep them up to date.

A number of publications issued by the Naval Air Systems Command (formerly Bureau of Naval Weapons) are of interest to the ABF. The General Information and Servicing section of the Maintenance Instructions Manual for each type aircraft covers the required procedures for refueling the aircraft. Mobile refuelers and aircraft handling equipment are covered by other Air Systems Command publications.

NOTE: As of 1 July 1974, the Naval Ship System Command and the Naval Ordnance Systems Command were combined to form the Naval Sea Systems Command. Because the majority of publications being used by ABF's still carry the NAVSHIP designation, this chapter will continue to use the NAVSHIP title.

Publications issued by the Naval Ship Systems Command (formerly Bureau of Ships) cover most of the shipboard equipment used by the ABF. The fuel system for each ship is covered in a Ship's Information Book (SIB). The SIB for the ship to which the ABF is attached should be studied thoroughly. Also, each major component (unit) is covered by a publication issued by the Ship Systems Command.

Spare parts for the aviation fuels systems are contained in the ship's allowance list. This is the Coordinated Shipboard Allowance List, known as the COSAL. The COSAL is an individual list prepared especially for each ship, and is based on the equipment actually installed or in use in each ship. It is published in book form in several segments, each segment covering a different type of material.

NAVSHIPS PUBLICATIONS

All necessary NavShips publications are issued directly to new vessels by the Naval Ship Systems Command about 6 months before commissioning. Requests for commissioning allowance should not be submitted unless the publications are desired at an earlier date or unless they have not been received a month before the commissioning date.

NavShips publications of interest to the ABF are listed and indexed in NavSup Publication 2002, Section VI.

NavSup Publication 2002 is a 13-section stock list of all the publications and forms used throughout the Navy. Section VI of this stock list is the basic index of the Naval Ship Systems Command publications. Section VI is further subdivided into six parts:

Part A–Administrative and general publications.

Part B–Ships electronic equipment publications.

Part C–Ships damage control texts and diagrams.

Part D–NavShips manufacturers' technical manuals (numerical listing).

Part E–NavShips manufacturers' technical manuals (alphabetical listing).

Part F–Ships general description and information books.

The ABF is primarily interested in Parts D and E, which list all NavShips manufacturers' technical manuals. In Part D, all publications are listed in numerical order according to stock number. Part E lists the same publications in alphabetical order according to title/nomenclature.

Requisitioning Procedure

Submit requests on the DOD Single Line Item Requisition System Document, DD Form 1348, in accordance with the Military Standard Requisitioning and Issue Procedure (MILSTRIP) (NAVSUP Pub 437).

DD Form 1348 must reflect the following information in the "remarks" section as applicable:

1. The publication requested is (1) to replace copies destroyed; (2) to increase allowance of a publication already held; or (3) to add a publication to the allowance of the activity.

2. Justification of requests for increases in allowance or for publications not already held.

When ordering publications, the full title and NavShips number must be furnished, if available. If the instructions book title and NavShips number are not available, the complete nameplate data on the machinery or equipment involved must be furnished. Complete instructions for ordering all NavShips publication are contained in chapter 9001 of the Naval Ships Technical Manual, NavShips 250-000.

MAKING CHANGES TO PUBLICATIONS

There are four mandatory requirements to be met in maintaining an allowance of publications. These requirements are:

1. The prescribed publications be on board.
2. The publications be maintained up-to-date.
3. The publications be ready for immediate use.
4. Applicable security provisions be observed.

Most changes to publications are issued either in the form of looseleaf pages, pen-and-ink changes, or complete revisions. When changes are issued in the form of numbered pages, the old page with the corresponding number is removed and the new replacement page inserted in its place. Specific instructions are normally given with each change on the method to be used in incorporating the change. Changes should be made immediately upon receipt.

A checklist of pages that are to remain in the publications after the change has been incorporated is provided with changes issued for some publications. This checklist should be compared against pages remaining in the publication to insure they agree. Extra pages are removed and missing pages ordered to bring the publication up to date. Obsolete pages removed should be secured together and retained until the next change is received; sometimes the wrong pages are removed from a publication when a change is entered and the error is not discovered, even with the checklist, until the next change is entered.

When pen-and-ink changes are made, the change number and date should be entered with each change for future reference. Sometimes it is convenient to cut out pen-and-ink changes and insert them in their proper place in a publication by fastening them with transparent tape or mucilage.

A record sheet is normally maintained in the front of each publication indicating the date and number of each change incorporated and the name or initials of the person completing the change. This makes it relatively simple to ascertain if the publication is up to date.

CLASSIFIED PUBLICATIONS

The Chief of Naval Operations is responsible to the Secretary of the Navy for all policies relative to maintaining the security of all classified information within the Naval Establishment. Due to the close relationship of counterintelligence and the preservation of security, the Director of Naval Intelligence has been designated as the officer primarily responsible to the Chief of Naval Operations for the protection of classified information. Therefore, the Office of Naval Intelligence formulates and promulgates Navy policies which relate to the security of all classified information.

Commanding officers are directly responsible for safeguarding all classified information within their commands and are responsible for instructing their personnel in security practices and procedures.

An ABF assigned to handle or destroy classified matter should thoroughly familiarize himself with the provisions contained in OPNAV INST. 5510.1 (Series) which is the Department of the Navy Supplement to the DOD Information Security Program regulations.

INSTRUCTIONS AND NOTICES

The Navy Directives System is used throughout the Navy for the issuance of nontechnical directive type releases. These directives may establish policy, organization, methods, or procedures. They may require action to be taken or contain information affecting operations or administration. This system provides a uniform plan for issuing and maintaining directives. Conformance to the system is required of all bureaus, offices, activities, and commands of the Navy. Two types of releases are authorized under the plan—Instructions and Notices.

Information pertaining to action of a continuing nature is contained in Instructions. An Instruction has permanent reference value and is effective until the originator supersedes or cancels it. Notices contain information pertaining to action of a one-time nature. A Notice does not have permanent reference value and contains provisions for its own cancellation.

For purposes of identification and accurate filing, all directives can be recognized by the originator's abbreviation, the type of release (whether an Instruction or Notice), a subject classification number; and, in the case of Instructions only, a consecutive number. Because of their temporary nature, the consecutive number is not assigned to Notices. This information is assigned by the originator and is placed on each page of the directive.

ABF's will be more concerned with NAVSHIPSYSCOM and NAVAIRSYSCOM Instructions and Notices that are issued to aviation commands pertaining to aviation fuels and aviation fuels equipment.

BLUEPRINTS AND DRAWINGS

Each ship has a certain allowance of blueprints that must be properly filed, inventoried, and kept up-to-date. One set of blueprints for the entire ship should be filed in the engineering log room or damage control central. A set of blueprints covering the fuels systems should be filed by the V-4 division.

FILING

You must have an understanding of the group classification and numbering system used in the filing of blueprints. The Navy Filing Manual lists the filing numbers and the corresponding subject matter; the same system is used for numbering the various chapters in NavShips Technical Manual.

For shipboard use, the most satisfactory method of filing blueprints or plans is to fold them and insert them in manila envelopes. Each envelope should be labeled with the following information written in the upper left corner–group classification, plan number, alteration number (if any), and plan title.

The number assigned to a blueprint for identification is composed of several groups. For example, in NavShips plan number CVA34-S4700-1567 or CVA34-504-1567, Alt. 4, the CVA group is the class of ship; the S4700 or 504 group, a pump, is the group classification number; the 1567 group is the individual plan number; and the Alt. 4 is the fourth alteration to the equipment. If the latest alteration to the equipment has not been completed, the previous plan should also be on file. After the alteration has been completed the out-of-date plan should be destroyed.

The plan title should include the name of the unit, the equipment, the space where located, or the type of system.

The plans should be filed numerically by the group classification number. All plans for a given ship should be listed in the Ship's Plan Index. This index, listed in numerical order, should contain the group classification number, plan number, alteration number, and title. By knowing the group classification number, the print should be quickly located.

READING

The maintenance, repair, and understanding of a fuel system depends on the ability of personnel to read blueprints and drawings. Technical manuals consist of the text and drawings which depict the operation, parts, and construction of pumps and other pieces of equipment. Diagrams contain symbols which depict the location of various valves, pumps, etc. Detailed information concerning the reading and making of blueprints and drawings can be found in Blueprint Reading and Sketching, NavPers 10077 (Series).

SUPPLY

It is essential that ABF's know certain phases of supply in order to procure and maintain equipments in accordance with current regulations. They must be familiar with the publications used in identifying material, equipment, and spare parts utilized in the performance of the duties of their rating. In addition, ABF's must be familiar with the quantities of material and equipment authorized, and the authorization for these allowances. They must also know procedures used in procuring, expending, inventorying, and maintaining custody of material.

In association with supply, the ABF will find that most of the spare parts and other supply items are under the cognizance of the Ship Systems Command and, in most instances, are kept in the general store section of supply, and that dealing with supply primarily involves the submission of chits for the drawing of spare parts. The following information should be helpful in the ABF's relation with the supply department.

The primary purpose of the Ship's Parts Supply System is to receive, stow, and issue repair parts for the essential maintenance of ships of the fleet. Major shipboard equipment, cognizance symbol S material, is under direct control of the Ship Systems Command. The ship's repair parts, cognizance symbol H material, are controlled by the Ship's Parts Control Center (SPCC), Mechanicsburg, Pa.

IDENTIFICATION OF SPARE PARTS AND EQUIPAGE

In order to procure the desired material or to properly conduct an inventory of materials on hand, the ABF must be able to identify the material or equipment concerned. The nameplate attached to some equipment furnishes data helpful in identifying the equipment. However, when procurement requests are initiated, it is very important that the correct National stock number, complete nomenclature, part number, and reference be furnished the supply officer to prevent ordering unsuitable material. This information can normally be obtained from Navy stock lists and applicable technical manuals, parts lists, change bulletins, and allowance lists.

TOOLS OF IDENTIFICATION

It is imperative that the ABF be able to identify the material or equipment required for replacement or repair of the equipment installed aboard ships. It is imperative because it enables the ships to achieve maximum operating capability for extended periods of time without external logistic support. The following paragraphs discuss some of the tools used to identify all installed equipment and machinery aboard ships.

Coordinated Shipboard Allowance List (COSAL)

The COSAL provides nomenclature, operating characteristics, specifications, parts lists, and other technical data pertaining to all installed equipment and machinery, and nomenclature and characteristics of the equipage, and tools required to operate and maintain the ship and its equipment.

The COSAL is a supply management document in that it provides the supply officer with listings of what material to stock in his storerooms and how many of each item of equipage must be carried aboard ship.

During peacetime operations, the ship's operating schedule is usually pretty well known. The supply officer is able to replenish the storerooms for an operation because he knows where the ship is going, how long it will be gone, and what supply support will be available during the trip. During wartime or other emergency, the duration and destination of a ship may not be known. The supply officer must then insure a capacity load to provide for the ship's requirements for an indefinite period of time. For most operating supplies, he has the past records of what has been used, and from these he can calculate a balanced load that will provide the maximum days of support.

The key word in COSAL is COORDINATED. Computers assemble all of the allowed parts from the hundreds of APL/AEL's into two lists of repair parts to be stocked by the ship. These lists are prepared by the Ship's Parts Control Center (SPCC) and the Electronics Supply Office (ESO) and cover the equipments supported by them. The personnel who prepare these lists take into account all of the installed equipment on board, the quantity of each item of that equipment, the failure rate of parts, and the relative importance of these parts to the operation of the equipment.

Thus, the COSAL, aided by experience and advice from technical ratings, enables the supply officer to stock the necessary items to meet the requirements for repair parts.

Obviously, not all of the parts listed in the COSAL can be carried as spares; to do so would require a complete set of spare equipment and machinery in the storeroom–this, of course, is impossible.

The COSAL does not include ship's store stocks, resale clothing, bulk fuels, subsistence items, expendable ordnance, or repair parts for aircraft. These items are covered by separate outfitting and loadlists.

The COSAL is published by the various activities listed below. These activities are responsible for preparation and maintenance of each ship's COSAL based on type and mission of the ship and the equipment on board. Each activity is responsible for different types of equipment.

Ship Parts Control Center (SPCC):
  Hull, Mechanical, Electrical, and
  Ordnance Equipment

Electronics Supply Office (ESO):
  Electronics Equipment

Aviation Supply Office (ASO):
  Aviation Equipment

Naval Electronics Systems Command (NavElex):
  Portable Communication, Radiac,
  and Electronic and Electric Test
  Equipment.

The ESO and SPCC COSAL's are similar in purpose but have some minor differences in format. The ABF is primarily concerned with the SPCC COSAL which covers hull, mechanical, electrical, and ordnance equipment; therefore, this COSAL is covered in this chapter.

The SPCC COSAL includes an introduction section which gives detailed descriptions of the parts and contents, information to aid in its use, and procedures for making corrections. When studying the illustrations later in this chapter, notice the extensive use of codes and abbreviations. This is necessary because of the large amount of information that must be shown in a restricted amount of space. The Introductions define these codes and abbreviations. It is not necessary for you to memorize them at this time, but it is important for you to understand the type of information they impart in the different data elements of the COSAL pages. While studying the illustrations, analyze each block or column of information to see how these codes and abbreviations are used to help the ABF do a better job. The SPCC Introduction also contains an index of equipage and consumable items crossreferenced to the AEL category (the first six digits of the AEL number.)

The SPCC COSAL is divided into the following parts and sections:

Part I

Summary of Effective Allowance Parts/Equipage Lists (Short Title–"Summary")
Index–Section A
Index–Section B

Part II

Section A. Allowance Parts List (APL)
Section B. Allowance Equipage List (AEL)

Part III

Section A. Storeroom Items (SRI) Stock Number Sequence List (SNSL)
Section B. Operating Space Items (OSI) Stock Number Sequence List (SNSL)
Section C. Not used at this time.
Section D. Alternate Number Cross Reference to Stock Number. Section D is published and included only with the COSAL prepared by SPCC.
Section E. Generally used, consumable, nonequipment related items; for initial outfitting of a ship's operating spaces and storerooms.

Summary.–The Summary of Effective Allowance Parts/Equipage Lists is a numerical list of all APL's and AEL's which are included in the ship's SPCC COSAL. This Summary may be used to check part II for missing APL/AEL's when a new COSAL is received, and periodically thereafter. It should be kept current by adding or deleting identification numbers as changes are made to the COSAL. Figure 10-1 is an example of a Summary page showing the columns and numerical sequence of identification numbers, with a description of the information it contains.

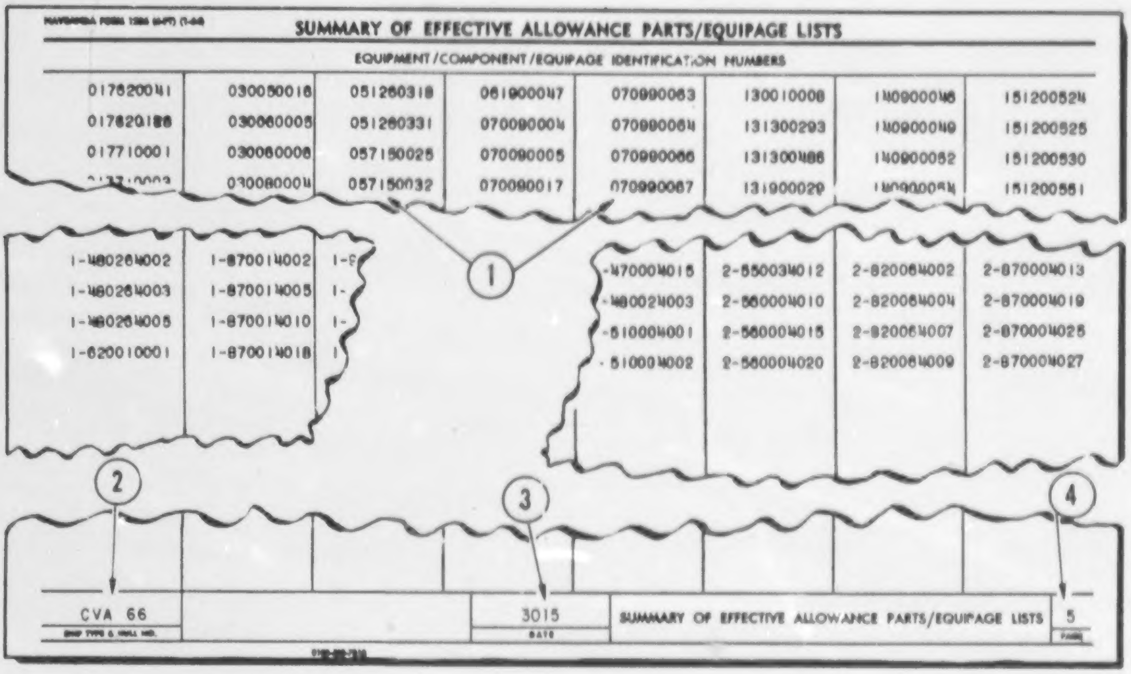
Index.–The Index is published in two parts, Section A and Section B. Both sections contain exactly the same information but arranged in such a manner that they provide a cross-index of all APL/AEL's in part II. Figure 10-2 shows both the A and B index. All areas of information are in the same relative positions except column 8. The SPCC COSAL requires a more comprehensive index than the other COSAL's because of the nature of the equipment it supports.

Electronic and ordnance equipments are usually manufactured to meet Navy specifications, and the parts are interchangeable between the equipments regardless of the manufacturer. This is not usually the case in engineering equipment and machinery. For example, the Navy needs electric motors, 440 volts a.c., 1 hp, 3,500 rpm. They are purchased from General Electric Co., Westinghouse Electric Corp., and other manufacturers. These motors have the same electrical and performance characteristics, but it is improbable that any of the parts are interchangeable.

ABF's must be able to locate the correct index entry for an item, and for this reason, the index also explains the service application or use for each item of equipment. The service applications for the above motors might be a laundry extractor and a ventilation fan. With this information, it is a simple matter to identify the correct APL.

When using the SPCC Index ABF's have two methods of entry. An APL/AEL number can be obtained by looking for the name of the equipment in Section A, or by looking for the use of that equipment in Section B. With practice you will become familiar with the terms used to describe the various service applications or equipment systems aboard your ship. Regardless of whether you use the information in column 2 (Section A) or column 8 (Section B) to identify an APL/AEL number, the information in the remaining column will enable you to correctly identify the number.

Allowance Parts List (APL).–The APL is a technical document prepared for a specific item



SUMMARY OF EFFECTIVE ALLOWANCE PARTS/EQUIPAGE LISTS

EQUIPMENT/COMPONENT/EQUIPAGE IDENTIFICATION NUMBERS

017620041	030050016	051260318	061900047	070990063	130010008	140900046	151200524
017620186	030060005	051260331	070090004	070990064	131300293	140900049	151200525
017710001	030060008	057150025	070090005	070990066	131300486	140900052	151200530
[illegible]	030080004	057150032	070090017	070990067	131900029	[illegible]	151200551

1-480264002	1-870014002	1-[illegible]
1-480264003	1-870014005	1-
1-480264005	1-870014010	1-
1-620010001	1-870014018	1

-470004015	2-550034012	2-820064002	2-870004013
-480024003	2-560004010	2-820064004	2-870004019
-510004001	2-560004015	2-820064007	2-870004025
-510004002	2-560004020	2-820064009	2-870004027

CVA 66		3015	SUMMARY OF EFFECTIVE ALLOWANCE PARTS/EQUIPAGE LISTS	5
SHIP TYPE & HULL NO.		DATE		PAGE

1. Equipment/Component/Equipage Identification Numbers – The APL and AEL Identification Numbers in numerical sequence starting at the top of the page and continuing to the bottom and from left to right.
2. Ship Type and Hull No.–The specific ship for which the Summary is published.
3. Date–May be shown as a Julian date (3015) (15 January 73) or as month-day-year (01-15-73).
4. Page–Consecutive page number of the Summary.

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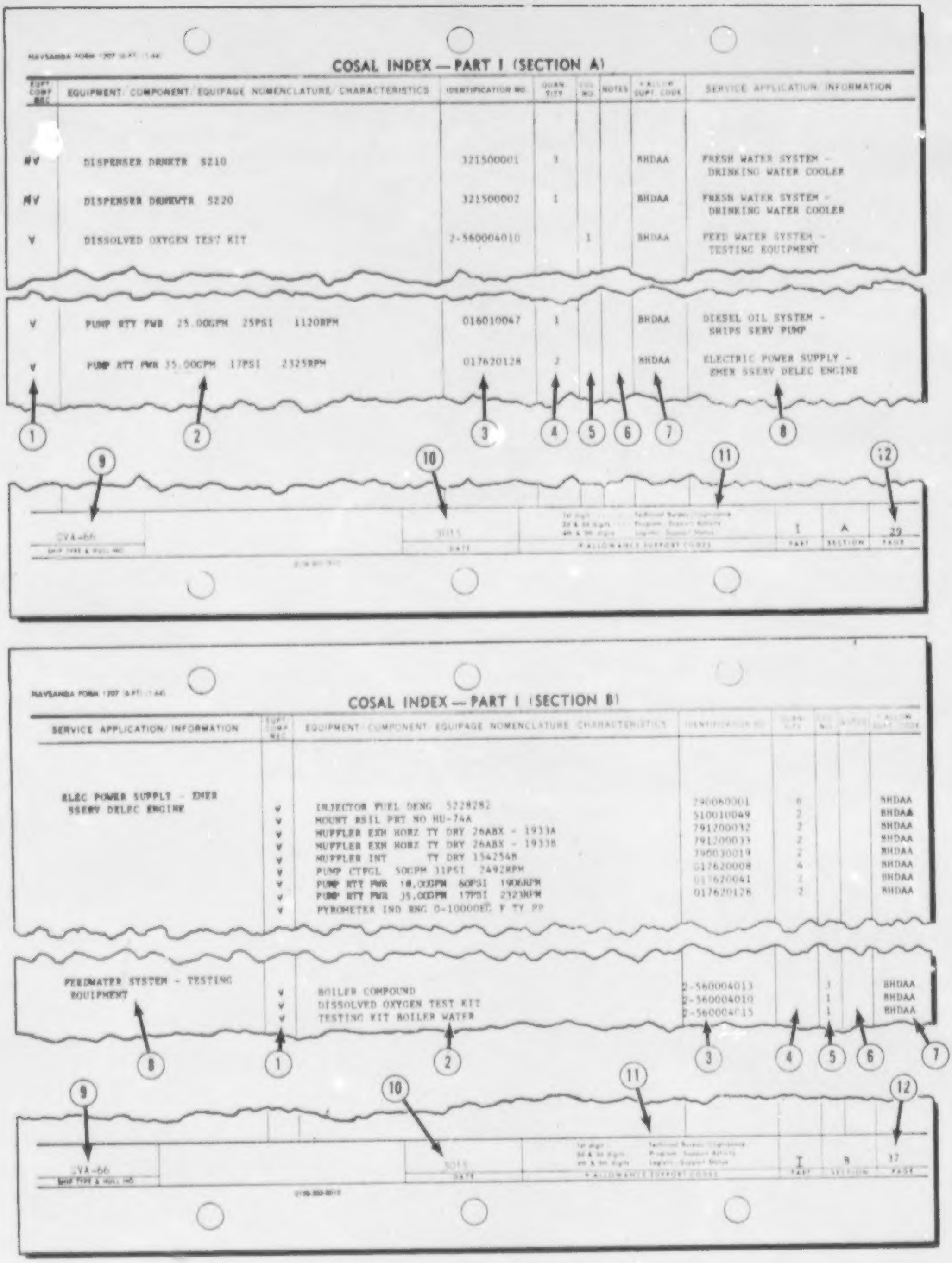
Figure 10-1.–Summary of effective allowance parts/equipage lists.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11
12

COSAL INDEX — PART I (SECTION A)

EQPT COMP REC	EQUIPMENT/ COMPONENT/ EQUIPAGE NOMENCLATURE/ CHARACTERISTICS	IDENTIFICATION NO	QUANTITY	COL NO	NOTES	ALLOW SUPT. CODE	SERVICE APPLICATION/ INFORMATION
#V	DISPENSER DRNKTR 5210	321500001	3			BHDAA	FRESH WATER SYSTEM - DRINKING WATER COOLER
#V	DISPENSER DRNKWTR 5220	321500002	1			BHDAA	FRESH WATER SYSTEM - DRINKING WATER COOLER
V	DISSOLVED OXYGEN TEST KIT	2-560004010		1		BHDAA	FEED WATER SYSTEM - TESTING EQUIPMENT
V	PUMP RTY PWR 25.00GPM 25PSI 1120RPM	016010047	1			BHDAA	DIESEL OIL SYSTEM - SHIPS SERV PUMP
V	PUMP RTY PWR 35.00GPM 17PSI 2325RPM	017620128	2			BHDAA	ELECTRIC POWER SUPPLY - EMER SSERV DELEC ENGINE

CVA-66		3015	ALLOWANCE SUPPORT CODES	I	A	29
SHIP TYPE & HULL NO		DATE		PART	SECTION	PAGE

COSAL INDEX — PART I (SECTION B)

SERVICE APPLICATION/ INFORMATION	EQPT COMP REC	EQUIPMENT/ COMPONENT/ EQUIPAGE NOMENCLATURE/ CHARACTERISTICS	IDENTIFICATION NO	QUANTITY	COL NO	NOTES	ALLOW SUPT. CODE
ELEC POWER SUPPLY - EMER SSERV DELEC ENGINE	V	INJECTOR FUEL DENG 5228282	290060001	6			BHDAA
	V	MOUNT RSIL PRT NO HU-74A	510010049	2			BHDAA
	V	MUFFLER EXH HORZ TY DRY 26ABX - 1933A	791200032	2			BHDAA
	V	MUFFLER EXH HORZ TY DRY 26ABX - 1933B	791200033	2			BHDAA
	V	MUFFLER INT TY DRY 154256B	790030019	2			BHDAA
	V	PUMP CTFGL 50GPM 31PSI 2492RPM	017620008	4			BHDAA
	V	PUMP RTY PWR 10,00GPM 60PSI 1906RPM	017620041	2			BHDAA
	V	PUMP RTY PWR 35,00GPM 17PSI 2323RPM	017620128	2			BHDAA
	V	PYROMETER IND RNG 0-10000EC F TY PP					
FEEDWATER SYSTEM - TESTING EQUIPMENT	V	BOILER COMPOUND	2-560004013		3		BHDAA
	V	DISSOLVED OXYGEN TEST KIT	2-560004010		1		BHDAA
	V	TESTING KIT BOILER WATER	2-560004015		1		BHDAA

CVA-66		3015	ALLOWANCE SUPPORT CODES	I	B	37
SHIP TYPE & HULL NO		DATE		PART	SECTION	PAGE

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Figure 10-2.—COSAL index.

or component of equipment, and lists descriptive data and characteristics of the equipment, repair parts, and other technical and supply management information. The COSAL binder should contain an APL for every item or component of equipment on board.

Each APL is assigned a nine-digit identifying number by SPCC. The first two digits identify the equipment/component category and are listed in an index in the COSAL Introduction. As ABF's become familiar with the COSAL they learn the more frequently used categories. The APL's are filed in numerical sequence in Part II of the COSAL.

ABF's may encounter an APL number containing a letter "P" prefix–this indicates an incomplete APL. The body of the APL usually tells why it is incomplete and the action being taken or required to complete it.

An APL does not always cover a complete equipment. Take another look at the Section B Index, figure 10-2. The first entry is "ELEC POWER SUPPLY–EMER SSERV DELEC ENGINE." This is the name of a complete system or equipment, the diesel electric engine for emergency ship's service electrical power supply. Column 2 lists the various components of the diesel electric engine, each of which, in this case, has its own APL number. Thus, the APL may cover a complete equipment or only one component of that equipment.

Allowance Equipage List (AEL).–The AEL is similar in appearance to the APL, but where the APL is designed to provide maintenance and repair support for ship's equipment, the AEL provides allowances of equipage and supplies necessary to support the ship's mission. The APL provides technical information for maintaining a piece of equipment and indicates the repair parts the supply officer should include in the storeroom to support it. The AEL provides the commanding officer, supply officer, and other heads of departments with listings of equipage and supplies that are required to enable the ship to operate efficiently and effectively.

Equipage is a term used to designate items of a durable nature that are not consumed in use and are essential to the ship's mission. Some examples of equipage are–typewriters, portable power tools (electric drills, pneumatic hammers, etc.), life preservers, special clothing, and test sets.

Through the use of AEL's, an equipage allowance can be tailored to fit the needs of a specific ship, and the commanding officer is responsible for carrying the full allowance on board. The consumable supplies listed on the AEL's are not mandatory allowances, but they provide a guide to be used by the supply officer and using department in determining what is to be ordered.

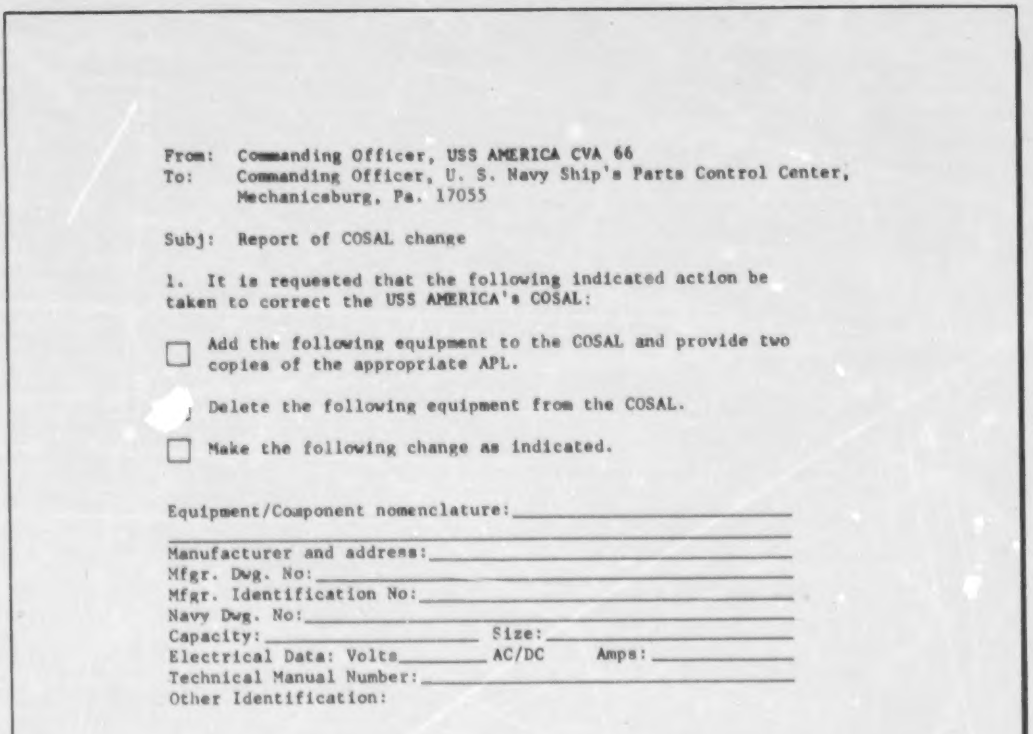
USING THE SPCC COSAL.–After ABF's become familiar with the indexes they will find the COSAL easy to use. The best way to gain this familiarity is by studying the COSAL for your ship. Read the entries in both the A and B Indexes, then see how they provide a cross-index by using the same entries but in a different sequence. When studying the entries, refer to the Introduction for the meanings of abbreviations that are not understood.

MAINTAINING THE COSAL.–In order to have an up-to-date COSAL, consider some of the changes that are necessary to keep it that way. Remember, if every component of every installed equipment is not included in the COSAL, it cannot do the job it has been designed to do. Briefly, a report must be made when any of the following changes occurs:

1. Equipment is received aboard ship.
2. Equipment is removed from the ship.
3. Equipment is changed to a different service application.
4. An error in nameplate data is discovered.

Bear in mind that many changes actually involve two reporting actions; e.g., when a replacement equipment/component is installed, reports are required for both the receipt of the new item and the disposition of the old.

REPORTING CHANGES TO SPCC.–Changes are reported to SPCC by letter, which may be similar to that shown in figure 10-3. The COSAL Introduction sets forth the type of information that should be included in the letter for the various types of change. A



From: Commanding Officer, USS AMERICA CVA 66
To: Commanding Officer, U. S. Navy Ship's Parts Control Center,
Mechanicsburg, Pa. 17055

Subj: Report of COSAL change

1. It is requested that the following indicated action be taken to correct the USS AMERICA's COSAL:

☐ Add the following equipment to the COSAL and provide two copies of the appropriate APL.

☐ Delete the following equipment from the COSAL.

☐ Make the following change as indicated.

Equipment/Component nomenclature: ____________________
____
Manufacturer and address: ____________________
Mfgr. Dwg. No: ____________________
Mfgr. Identification No: ____________________
Navy Dwg. No: ____________________
Capacity: __________ Size: __________
Electrical Data: Volts ______ AC/DC Amps: ______
Technical Manual Number: ____________________
Other Identification:

APL Number: __________
Service Application: ____________________
Quantity Installed: ______

198.125

Figure 10-3.—Sample form letter for use in reporting COSAL changes to SPCC.

method of determining what nameplate data SPCC needs to correctly identify an equipment/component to an APL number is to refer to an APL covering a similar equipment/component and use the characteristics section as a guide.

Fleet Oriented Consolidated Stock List

The Fleet Oriented Consolidated Stock List (FOCSL) is prepared by the Navy Fleet Material Support Office and is designed to afford relief of workload for shipboard personnel. The many stock catalogs are impractical for shipboard use because they are bulky in size, they differ in format, they include much data never used aboard ship, and they require an excessive amount of time to maintain. The FOCSL was developed in order to substantially reduce the number of supply catalogs required to be maintained by tailoring catalog information to those items of interest to Navy personnel.

Prior to the development of the FOCSL, it was necessary to search through several cross-reference listings published by the various inventory managers to cross-reference a manufacturer's part number to a federal stock number. Part numbers for Navy interest items are now consolidated into the MASTER CROSS-REFERENCE LIST section of the FOCSL regardless of the controlling inventory manager. This section is a one-way listing from part numbers to Federal Item Identification Numbers (FIIN's) and includes the federal supply code for manufacturers. The part numbers are arranged in alphanumerical sequence.

Bimonthly CHANGE BULLETINS are published to update the Price and Management Data section and the Master Cross-Reference List section; a separate bulletin is issued for each. These change bulletins are cumulative and list necessary current information to update the applicable FOCSL sections. The information is presented in the same format as the basic section.

NAVY STOCK LIST OF AVIATION SUPPLY OFFICE

The Navy Stock List of the Aviation Supply Office lists and identifies material under the inventory management of the Aviation Supply Office (ASO). This material is identified by the cognizance symbol E or R prefixing the national stock number of the item.

Cross-Reference (NSN to Manufacturer's Part Number and Code)

This ASO stock list publication is a cross-reference from National stock numbers to manufacturer's part number and code.

Price Management Data Section

This ASO stock list publication contains the following information—the national stock number of the item, its unit price, its unit of issue, and its accountability code; new items; and deleted items. All classes of material are included in these sections.

Descriptive Sections

This ASO stock list publication contains a cross-reference from the characteristics of items to the National stock numbers.

Parts List Sections

This ASO stock list publication contains a cross-reference from part number to stock number, supersedure of numbers, additional model applications, equivalents, change of design information, maintenance and overhaul percentages, accountability codes, perishability and salvageability information, and indications as to whether items are included on allowance lists.

ALLOWANCE LISTS AND INITIAL OUTFITTING LISTS

Allowance lists and initial outfitting lists are prepared by the Naval Air Systems Command and the Aviation Supply Office. These lists contain firm allowances of supplies and equipage for commissioning and outfitting purposes.

Allowance Lists

Publications identified as allowance lists are lists of equipment and material determined from known or estimated requirements as necessary to place and maintain aeronautical activities in a material readiness condition. In the case of meteorological and photographic material, this requirement is extended to all applicable naval activities.

These allowance lists apply to shop and/or operational type items and actually spell out initial outfitting allowances and material readiness requirements of such items. Included in allowance lists are such items as parachutes, flight clothing, aircraft jacks, tools, aircraft handling and servicing equipment, etc. This material may be issued to operating activities either as organizational equipment or on custody from the supporting station (the supporting ship when operating aboard).

Initial Outfitting Lists

Publications identified as Initial Outfitting Lists apply to stock and usage type items (maintenance parts and consumables) and merely spell out the range and quantities of such items that are to be made available at the time of initial outfitting. Thereafter, the range and quantities of these items to be stocked are based upon local usage data and planned requirements. Initial outfitting lists contain lists of materials which are normally expected to furnish enough parts and consumables to last for a period of 90 days.

MAINTENANCE INSTRUCTIONS MANUALS

Maintenance Instructions Manuals contain limited information on part numbers and nomenclature of items. Occasionally, names of manufacturers of material ordered under subcontracts are listed. These publications are used principally by maintenance personnel as reference books rather than in connection with supply and the identification of material.

ILLUSTRATED PARTS BREAKDOWN LISTS

The Illustrated Parts Breakdown lists applicable to equipments under cognizance of the Naval Air Systems Command and details pertaining to their distribution are contained in the Navy Stock List of Forms and Publications, NavSup Publication 2002 Section VIII, Parts C and D. These lists contain the name and part or drawing number of each component part for the equipment to which the list applies. This list may be used to verify the equipment on which a part is to be installed, by checking the number stamped or affixed to the part against the part number listed in the applicable assembly parts list.

MANUFACTURER'S PARTS LISTS AND CATALOGS

Manufacturer's parts lists and catalogs are most helpful in identifying material for stock numbering and procurement purposes. Every activity has some equipment for which the Navy does not provide a catalog. In these cases manufacturer's publications are necessary to determine such information as nomenclature, identification numbers, and suppliers.

When a new piece of equipment is received, the manufacturer's publication furnished with the equipment should be kept for ready reference in identifying parts, and for the proper care and maintenance of the equipment concerned.

REQUEST FOR ISSUE

The ABF may encounter a variety of local requisitioning channels, all designed to satisfy material requirements. Procedures at the consumer level are somewhat flexible. Normally, the single line item requisition, DD Form 1348, is the form on which material is procured from the supply department. It is important that the correct stock number, manufacturer's part number, and nomenclature be included on all requests in order to expedite identification and issue. Incorrect or omitted information can lead only to confusion and delay in issue, or possibly the wrong part or material may be issued.

Afloat, the request document is presented to the aviation stores division for technical aeronautical material, or to the supply office for other than aeronautical material. While individual ships may employ different procedures, such as a credit card system, DD Form 1348 is normally the request document. When it is necessary for the ABF to draw parts or material from supply, he prepares a DD Form 1348 and presents it to the air officer or his authorized representative for signature. DD Form 1348 is then presented to the supply department for processing and receipt of material.

Ashore, the requisition may be presented directly to the supply warehouse or to an established retail issue outlet. Procedures may differ between shore stations, because of assigned levels of maintenance, geographical location of shops relative to supply facilities, and other factors. Normally, DD Form 1348 is the proper request document which is prepared and submitted in accordance with local instructions.

REQUESTS FOR IN-EXCESS MATERIAL

Aboard ship, requisitions for the following are considered as in-excess:

1. Equipage not on the ship's allowance list.
2. Equipage on the allowance list but in greater quantities than allowed.
3. Nonstandard consumable supplies when similar items are available in the supply system.
4. Repair parts not listed with quantities in ship's allowances for which a request can be justified.

Requests for in-excess material must be accompanied by a complete justification as to why the item is required and why authorized material will not suffice. If the item is required for use by all similar type activities, a recommendation should be made to include the item in an applicable allowance list. Except in an emergency, in-excess material cannot be issued by the supply officer until the request has been approved by competent authority.

Ashore, the ABF is not normally confronted with in-excess requirements. Accountable (plant account) material requirements are included in the activity's budget submission to the management systems command, and the granting of funds normally constitutes approval of the requirement.

REQUESTS FOR NONSTANDARD MATERIAL

Nonstandard material is material for which a national stock number has not been assigned. When preparing a DD Form 1348 for nonstandard material, it is imperative that complete information be furnished in order that the supply officer may positively identify the exact material, equipment, or part that is required. The following information should be furnished, if possible, when requesting nonstandard material:

1. Complete name of item.
2. Complete nomenclature of item.
3. Manufacturer's name.
4. Manufacturer's part of drawing number.
5. Name and address of a dealer where the material can be obtained.
6. The document or publication authorizing issue of the item.
7. Justification as to why standard material will not suffice.

Requests for nonstandard material are prepared on DD Form 1348 and forwarded to the supply officer in the same manner as a request for standard material.

SURVEYS

The Survey Request, Report, and Expenditure, NavSup Form 154, is the document used to reevaluate or expend lost, damaged, or deteriorated material from the records of the accountable officer, as required by U. S. Navy Regulations (1948). Rules and regulations governing surveys and the responsibility connected with the accounting for government property are of primary importance to every person in the naval service.

The survey requests provides a record showing the cause, condition, responsibility, recommendation for disposition, and authority to expend material from the records. Rough survey requests are prepared by the person or department head responsible for the material to be expended or reevaluated.

TYPES OF SURVEYS

There are two types of surveys with which the ABF should be familiar–formal and informal. Each activity normally prepares local regulations outlining the circumstances which determine whether a formal or informal survey is made. However, the commanding officer orders a formal survey in any case he deems it necessary to do so.

Formal Survey

A formal survey is required for those classes of materials or articles so designated by the bureau or Systems Command concerned, or when specifically directed by the commanding officer. A formal survey is made by either a commissioned officer or a board of three officers, one of whom, and as many as practicable, must be commissioned, appointed in either instance by the commanding officer.

Neither the commanding officer, the officer on whose records the material being surveyed is carried, nor the officer charged with the custody of the material being surveyed may serve on a survey board.

Informal Survey

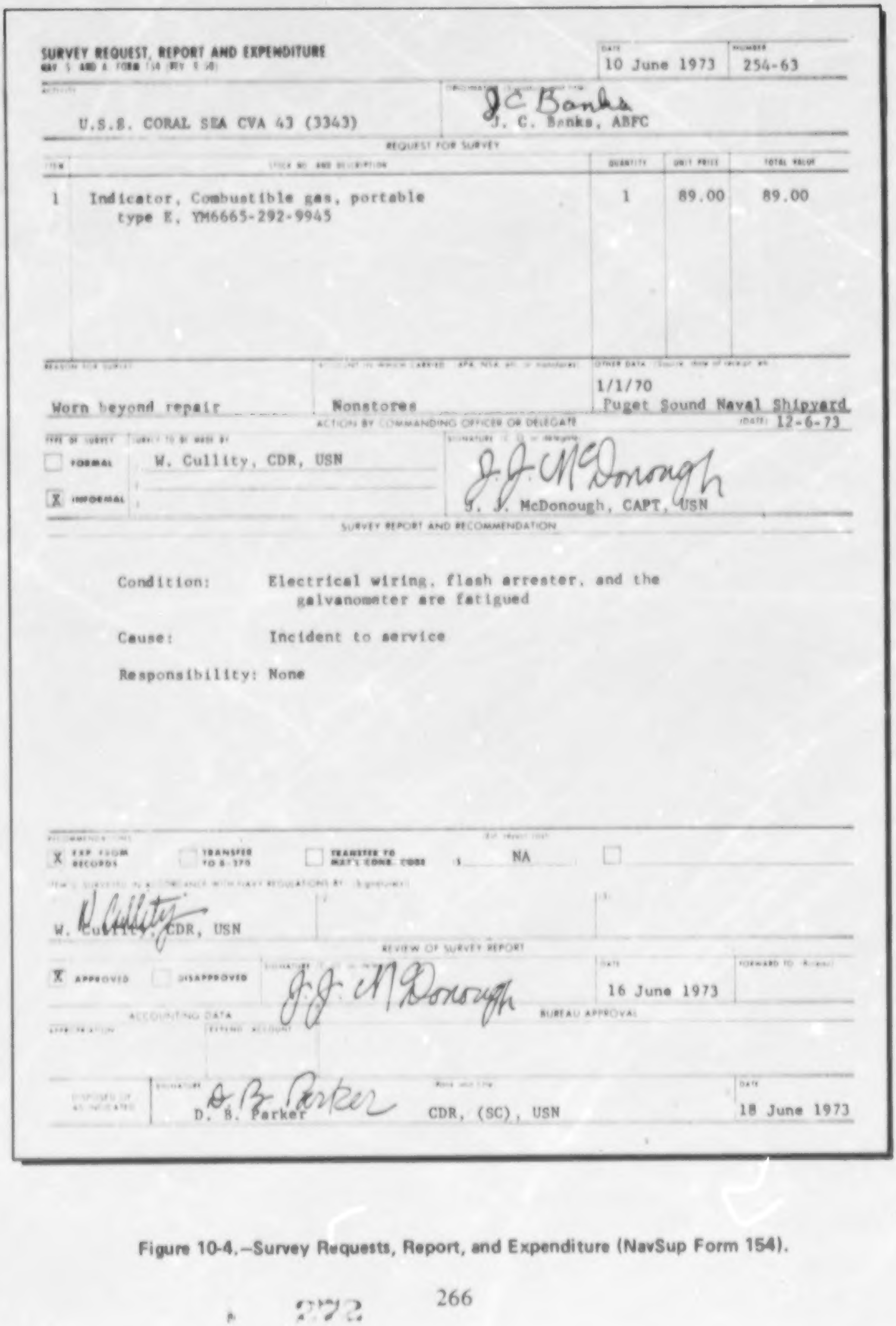
Informal surveys are made by the head of the department having custody of the material to be surveyed. Informal surveys are used in cases when a formal survey is not required or directed by the commanding officer. In the case of flight clothing, the aviator prepares and signs both the request and report sections of NavSup Form 154.

REQUEST FOR SURVEY

A request for survey may be originated by a department, division, or section head, or a designated subordinate as prescribed by local regulations. Normally, requests for survey are originated in the department having custody of the material being surveyed. The initial survey is made on a rough copy of NavSup Form 154. A statement by the originator is placed on or attached to the request for survey. Included in this statement is information relative to the condition of material; cause or condition surrounding the loss, damage, deterioration, or obsolescence of material; responsibility for cause or condition of material, or reason why responsibility cannot be determined; and recommendation for disposition of material or action to be taken.

Upon receipt of the rough copy, the designated group or section prepares a sufficient number of smooth copies of the request for distribution in accordance with local regulations. The smooth survey request is filled in down to the caption "Action by Commanding Officer or Delegate." (See fig. 10-4.) It is then forwarded to the commanding officer who will determine whether the survey will be formal or informal. If formal, the survey request is forwarded to the designated surveying officer(s); if informal, it is forwarded to the department for survey action.

The statement by the originator as to the cause, condition, etc., is attached to the smooth request for survey for evaluation by the surveying officer(s). After the survey has been completed by the head of department or surveying officer(s), it is returned to the commanding officer for review action. After approval by the commanding officer, the survey request is forwarded to the cognizant fleet command and/or bureau for final review and approval when so required. In the absence of special instructions, surveys are not forwarded to the Naval Air Systems Command for final



SURVEY REQUEST, REPORT AND EXPENDITURE

DATE: 10 June 1973
NUMBER: 254-63

U.S.S. CORAL SEA CVA 43 (3343)

J C Banks
J. C. Banks, ABFC

REQUEST FOR SURVEY

ITEM	STOCK NO. AND DESCRIPTION	QUANTITY	UNIT PRICE	TOTAL VALUE
1	Indicator, Combustible gas, portable type E, YM6665-292-9945	1	89.00	89.00

REASON FOR SURVEY: Worn beyond repair
Nonstores
OTHER DATA: 1/1/70 Puget Sound Naval Shipyard

ACTION BY COMMANDING OFFICER OR DELEGATE
(DATE) 12-6-73

☐ FORMAL
☒ INFORMAL

W. Cullity, CDR, USN

J. J. McDonough
J. J. McDonough, CAPT, USN

SURVEY REPORT AND RECOMMENDATION

Condition: Electrical wiring, flash arrester, and the galvanometer are fatigued

Cause: Incident to service

Responsibility: None

☒ EXP. FROM RECORDS ☐ TRANSFER TO S-270 ☐ TRANSFER TO MAT'L COND. CODE $ NA ☐

W. Cullity, CDR, USN

REVIEW OF SURVEY REPORT

☒ APPROVED ☐ DISAPPROVED

J. J. McDonough

DATE: 16 June 1973

ACCOUNTING DATA

BUREAU APPROVAL

D. B. Parker
D. B. Parker CDR, (SC), USN

DATE: 18 June 1973

198.99

Figure 10-4.—Survey Requests, Report, and Expenditure (NavSup Form 154).

review and approval. After approval, the supply officer expends items as directed by the approved survey.

Requests for replacement of surveyed items must be made with DD Form 1348, and must be accompanied by a certified copy of the approved survey request.

CULPABLE RESPONSIBILITY

When a person in the naval service is found to be culpably responsible by a surveying officer or board, the reviewing officer refers the entire matter to such a person for a statement. The reviewing officer must then take such disciplinary action as the circumstances require. He notes on the survey the action taken and informs the Chief of Naval Personnel and the bureau or Systems Command concerned as to the disciplinary action taken. In the case of officers, he must make recommendations as to the inclusion of a statement of the action taken in the record of the person concerned, and inform that person of the final decision in the matter. Action on the survey in respect to the material involved must not, however, be withheld pending disciplinary action.

CUSTODY OF EQUIPAGE

Equipage is the term normally used to identify nonexpendable material for which custodial responsibility is designated. Equipage, on which custody cards must be maintained, is defined as those items having an accountability code designation of "D," "E," "R," or "L." Accountability code "B" and "C" items do not require a custody card. Custody cards are not required for code "R" or "L" items after their installation or while in use.

Code B (Exchange Consumables) is applied to items which are consumable or expendable but normally require item-for-item exchange for replacement. Such items may contain precious metals, may be highly pilferable, or may be high-cost items.

Code C (Consumables) is applied to all other consumable or expendable items which do not require item-for-item exchange for replacement.

Code D (Equipage, Support Type) is applied to items of support equipment which are economical and practical to repair on a scheduled basis through a major rework activity. Code D items are maintained on a custodial basis and normally require item-for-item exchange for replacement.

Code E (Equipage, Locally Repairable, Support Type) is applied to items of support equipment which are to be repaired locally by the using or fleet support activity within their assigned maintenance responsibility. Code E items are maintained on a custody basis and normally require item-for-item exchange for replacement.

Code R (Equipage) is applied to repairable (except items of support equipment) items which are economical and practical to repair on a programmed basis through a major rework activity. Code R items are maintained on a custody basis in some cases, depending upon the use of the item. These items normally require item-for-item exchange for replacement.

Code L (Equipage, Locally Repairable) is applied to repairable (except items of support equipment) items which are to be repaired locally by the using or fleet support activity within their assigned maintenance responsibility. Code L items are maintained on a custody basis in some cases, depending on the use of the item. They normally require item-for-item exchange for replacement.

Equipage is issued by the supply officer to the head of the applicable department. The department head is held responsible to the commanding officer for this material. It is apparent that the head of department cannot personally keep track of all equipage for which he is held accountable. Therefore, he must delegate custodial responsibility to the division officers and leading petty officers using or having the material in their custody. When the ABF is assigned custodial responsibility, he is required to sign a memorandum receipt to his division officer or department head for the material for which he is held responsible.

The ABF should keep strict control over and know the location of his assigned equipment at all times. He can be held culpably responsible for material lost or damaged due to his negligence.

INVENTORY OF EQUIPAGE

Each department head is responsible for the annual inventory of equipage for which he is accountable. ABF's responsible for air department equipage are normally called upon to assist in taking this inventory. When equipage is inventoried, special care should be taken to note if it is serviceable and properly preserved and stowed, and to ascertain if it is still required by the department to perform its assigned mission. The ABF using this equipment is in the best position to make this decision. Therefore, he should make recommendations to the division officer or to the air officers as to the need for survey, expenditure, disposition, or acquisition of additional equipage.

EQUIPMENT RECORDS AND REPORTS

Maintaining records and reports is one of the major responsibilities of the ABF1 and ABFC. All records and reports must be accurate, up to date, and in accordance with established standards.

WORK AND MAINTENANCE LOGS

In the work (or operational) logs, hours of operation of equipment should be recorded. This information will be very useful in keeping current the maintenance project cards of the ship. Any other operational data that could be useful at a future date should be recorded. A daily inspection of the fuel system should be made for leaks and other discrepancies and recorded in the log.

The maintenance logbook should contain all work performed relative to the aviation fuels systems by the repair crews, and it should be recorded in a day-to-day order. The maintenance logbook should also be inspected frequently by appropriate petty officers and the division officer.

All logbooks maintained in the repair locker should be made in duplicate. The rough logs are kept in the repair locker, and the smooth logs should be kept in the V-4 division office.

INVENTORY CARDS

Inventory cards aid in control of the inventory of spare parts, tools, and equipment used in the maintenance and repair of aviation fuels systems. They are also a great aid in estimating the number and type of spare parts required over a period of time. A card should be made for each type of part and tool used in the division. This card should provide the name of the part, national stock number, part number, and price. The card should have spaces in which to enter the following information—the number of parts required by the allowance list or outfitting list, the number of parts on hand, and the number of parts on order and the date they were ordered. The individual keeping the file may file the cards in any order that he prefers, but it should be remembered that a file of this type is useless unless it is up-to-date.

FUEL EXPENDITURE

One of the major problems encountered by senior ABF's in the operation of aviation fuels systems is keeping accurate records of fuel expenditures. The measuring instruments (meters, liquid level gages, pneumercators) are not sufficiently accurate for use in computing fuel expenditure for a particular aircraft or squadron.

The most accurate way of computing the amount of fuel issued to a particular aircraft is with the use of the aircraft's fuel gages. By subtracting the fuel load at the time of arrestment from the total capacity of the aircraft's fuel tanks, it can be determined how much fuel is needed to top off its tanks. The aircraft's fuel gages are calibrated in pounds of fuel, and a conversion chart must be used to convert the pounds of fuel issued to gallons.

AIRCRAFT CHECKER REPORTS

Fuels checkers are assigned the duty of keeping an account of all aviation fuels issued to or taken from an aircraft.

Checkers cards or sheets made up on the ship are useful for this purpose. These cards or sheets should have places for the date and the checker's name at the top. There should be spaces on the cards for the squadron number, aircraft side number, the pounds of fuel issued or defueled from the aircraft, the total fuel load, the time of fueling or defueling, and the plane captain's initials. These cards should be turned in to the division petty officer responsible for keeping the fuel expenditure records. They are used in filling out squadron requisitions. The cards should also be filed for the purpose of showing the time of fueling and the fuel load in case of an aircraft accident. These cards are also used in accounting for the amount of fuel aboard the ship.

The fuel checker cards are used in conjunction with the daily pumproom reports to establish the amount of fuel delivered and the amount of fuel remaining aboard daily. Weekly, the cards are used to compute the amount of fuel used by each squadron. A supply requisition is sent to each squadron for payment for the amount of fuel used. The cost of the fuel is paid for out of that squadron's Operation and Line Maintenance of Aircraft Allotment.

PUMPROOM REPORTS

A report from each aviation fuels pumproom on the ship should also be turned in to the petty officer responsible for fuel expenditure records. This report should give the amount of fuel in each tank for which that pumproom is responsible. This report should show whether the fuel was transferred, discharged, or received. For gasoline pumprooms, this report should also show the inertness reading and the inert gas pressure in the cofferdams and double-walled piping.

DAILY FUEL REPORTS

The daily fuel report is compiled from the aircraft checker cards, the pumproom reports, issuing tanker or fuel farm requisition, and filling connection receiving logs. This report shows the total amount and type of aviation fuel on board. It also shows the date of the last refueling, the amount received, and the tanker or farm from which it was received. The cofferdam inertness readings are also shown on this report. This report is normally signed by the aviation fuels chief, the aviation fuels officer, the aircraft handling officer, the air officer, and the person making out the report.

The daily fuel report is normally a seven-copy report with a copy being submitted to each of the following:

1. Commanding Officer.
2. Air Officer.
3. Engineering Officer.
4. Aviation Fuels Officer.
5. OOD.
6. Operations Officer.
7. Aviation Supply Officer.

Another daily report submitted by V-4 division is the daily sounding report. This is a two-copy report with one copy being submitted to the engineering log room and the other copy being retained in the V-4 division files. The daily sounding report contains the tank number, capacity in gallons and feet and inches, the previous day's soundings, the present soundings, and the percentage of fuel on board.

Since liquids expand and contract as heat is added or taken away, it is necessary to use a conversion table to determine the true volume of fuel issued or received when the temperature of the fuel is above or below 60° F. It has been determined that this is the temperature at which the most accurate volume of fuel issued or received can be figured. Table 10-1 shows an example of the method of figuring this correction when the temperature of the fuel is 75° F.

Table 10-1.—Example of volume correction to 60° F

140,000 X 0.9948 = 139.272

Uncorrected quantity in U. S. gallons at 75° F

Volume correction factor for observed temperature of 75° F taken from ASTM-D1250, table 7 (API gravity 14.6 at 60° F)

U. S. gallons at 60° F

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QUALIFICATIONS FOR ADVANCEMENT

This booklet provides you with a list of the minimum qualifications for advancement to Aviation Boatswain's Mate third and second class. The official source of this list is the Manual of Qualifications for Advancement, NAVPERS 18068-C, 1971. The assignment numbers given opposite the qualifications refer to the assignments in the NRCC. Each course assignment contains information related to a practical or knowledge factor, as shown.

AVIATION BOATSWAIN'S MATE F 1 & C

Aviation Boatswain's Mates (F) operate, maintain, and perform organizational maintenance on aviation fueling and lubricating oil systems in CVA, CVS, LPH and LPD's including aviation fuel and lubricating oil service stations and pumprooms, piping, valves, pumps, tanks, and portable equipment related to the fuel system; operate, maintain, and repair valves and piping of purging and protective systems within the Air Department spaces aboard ship; supervise the operation and servicing of fuel farms, and equipment associated with the fueling and defueling of aircraft ashore and afloat; operate and service motorized fueling equipment; maintain fuel quality surveillance and control in aviation fuel systems ashore and afloat; train, direct, and supervise firefighting crews, fire rescue teams, and damage control parties in assigned fuel and lubricating oil spaces; and observe and enforce fuel-handling safety precautions.

QUALIFICATIONS FOR ADVANCEMENT	Required for Advancement to	Covered in Assignment
A. SAFETY		
1.00 Practical Factors		
.81		
b. Aviation fuel systems and related equipment; establish safeguards, procedures, and standards to ensure compliance by personnel supervised	E-7	3, 4, 8
D. AVIATION FUEL SYSTEMS AND EQUIPMENT		
1.00 Practical Factors		

QUALIFICATIONS FOR ADVANCEMENT		Required for Advancement to	Covered in Assignment
.60	Analyze malfunctions of aviation fuel system portable test equipment and determine corrective action	E-6	7
.61	Analyze malfunctions in the aviation fuel and lube oil systems and the nitrogen distribution system and determine corrective action. (Note: Personnel in the ABF Service Rating are responsible only for that portion of the nitrogen distribution system aboard carriers beginning at the stop valves in aviation fuel pumprooms. The Engineering Department is responsible for the oxygen/nitrogen producing plant and the nitrogen distribution system up to the stop valves in the aviation fuel pumprooms.)	E-6	2, 4, 5
.62	Maintain fuel and lube oil inventories; prepare daily fuel reports	E-6	5, 6, 8
.63	Perform calibrations, adjustments, and tests in the aviation fuel and lube oil systems	E-6	4, 5, 7
.80	Inspect installation and evaluate operation of repaired or newly installed parts and components of aviation fuel systems and related equipment	E-7	6, 7
.81	Supervise inspection and operation of aviation fuel systems	E-7	3, 4, 6
.82	Supervise the maintenance and repair of aviation fuel systems, including tanks, pumps, motors, piping, fittings, and hoses. (Note: When welding or brazing operations are required, the services of the Engineering Department are obtained)	E-7	6
2.00	Knowledge Factors		
.60	Procedures for steaming, flushing, and cleaning the aviation fuel and lube oil systems	E-6	2, 3, 4, 5
.62	Principles and maintenance requirements of centrifugal purifiers	E-6	6
.82	Procedures for maintaining quality assurance, use of AEL detectors, surveillance of aviation fuel, and actions to be taken when contamination is found	E-7	6
F.	CRASH RESCUE AND DAMAGE CONTROL		
1.00	Practical Factors		
.59	Direct: c. Aviation fuel damage control repair party	E-6	7
.80	Organize: a. Aviation fuel damage control repair party	E-7	7

QUALIFICATIONS FOR ADVANCEMENT		Required for Advancement to	Covered in Assignment
G.	GENERAL MAINTENANCE PRACTICES AND PROCEDURES		
1.00	Practical Factors		
.60	Interpret blueprints and drawings and make working sketches	E-6	8
.80	Screen defective components for feasibility of repair	E-7	5, 7
Z.	ADMINISTRATION		
1.00	Practical Factors		
.59	In accordance with the Planned Maintenance Sub-System of the Navy Maintenance and Material Management System:		
	b. Prepare a weekly schedule of preventive maintenance	E-6	*
	c. Prepare a Planned Maintenance System Feedback Report	E-6	*
	d. Assist in the preparation of a quarterly schedule of preventive maintenance	E-7	*
.60	Enter test data and work accomplished in logs and equipment histories	E-6	3, 8
.61	Prepare and evaluate:		
	a. Equipment failure reports	E-6	*
	b. MAF's, SAF's, UR's, TDC's and MHA cards	E-6	*
.62	Identify tools, equipment, parts, and material by nomenclature and stock number and prepare supply requisitions to obtain replacements	E-6	8
.63	Conduct inventories and maintain custody records	E-6	8
*.70	Post changes and additions to COSAL including:		
	a. Adding or deleting Allowance Parts List (APL) or Allowance Equipment List (AEL) items	E-6	8
	b. Correcting COSAL Index	E-6	8
.80	Supervise the use, filing and maintenance of publications, logs, and records	E-7	8
.81	Prepare for extended operations by ensuring spare parts, equipment, and personnel requirements	E-7	8
.82	Supervise inspection procedures to ensure that applicable technical specifications and standards of workmanship are met	E-7	6, 7, 8
*.87	Enter changes to Ship Equipment Configuration Accounting System (SECAS) and submit report to SECAS VALIDATION FIELD OFFICE (VFO)	E-7	8

* 100% covered in Military Requirements for Petty Officer 3 & 2, Chapters 13 and 14, NAVPERS 10056-C

AVIATION BOATSWAIN'S MATE F 1 & C

NAVEDTRA 10304-C

This course was prepared by the Naval Education and Training Program Development Center, Pensacola, Florida, for the Chief of Naval Education and Training

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This assignment booklet (including answer sheets) is a part of a training package combining the Rate Training Manual and Nonresident Career Course.

Each assignment is made up of a series of items based on assignment readings in the textbook. At the beginning of each assignment is listed the specific text material that should be studied. The answer sheets to be completed are enclosed as a separate package.

WHO WILL ADMINISTER YOUR COURSE

Your nonresident career course may be administered by your Command, or in the case of small commands your course may be administered by the Naval Education and Training Program Development Center. If you are attached to a branch of the Armed Forces other than the U.S. Navy, or are a member of a Foreign Armed Service, or an officer in the U.S. Navy, this course will be administered by the Naval Education and Training Program Development Center. Consult your Division Officer and follow the instructions stated below for local administration if your course is administered by your Command. Follow the instructions for Naval Education and Training Program Development Center administration if your course will be administered by the Center.

TO GET THE MOST OUT OF THIS COURSE

If there is an errata sheet included with this course, make all indicated changes and corrections in the assignment booklet and textbook.

Study those pages of the textbook listed for each assignment. Pay particular attention to the illustrations as they give a lot of information in a small space. Making your own drawings will help you understand some of the explanations you read.

When you have finished the required readings for an assignment, answer the items in the assignment booklet. Read each item carefully. Consult your textbook to help you select the best answer. Indicate your answer directly on the answer sheet by erasing the appropriate block.

You may find that some of the text content has become obsolete since the text was written. However, since the course is based on the textbook, in answering items be sure to select the best answer from the information in the textbook. The obsolete matter in the textbook will be brought up to date when the text is revised.

Use only the designated answer sheet for each assignment. Follow the directions found on the answer sheet to determine the proper procedures for completing it.

To complete this course successfully, you must meet the following standard: If you are on active duty, the average of the grades earned on all assignments must be at least 3.2. If you are not on active duty, the average of the grades earned on all assignments in each creditable unit of the course must be at least 3.2. (See the Naval Reserve Retirement box for the retirement points evaluated for this course.)

WHEN THE COURSE IS ADMINISTERED BY YOUR COMMAND

Adhere as closely as possible to a schedule of completing at least one assignment per month. Unnecessary delay in completing the course may prevent you from becoming fully qualified to take the regularly scheduled fleet-wide competitive examination for advancement.

Before completing the answer sheet, fill in all blanks at the top of the answer sheet.

Submit your completed assignments to the officer administering your course. He will discuss with you any of the questions that you do not understand. When the entire course has been completed and a satisfactory grade attained, a notation to this effect should be made by your local command in your service record. By this means you will be given credit for your work.

The Naval Education and Training Program Development Center does not issue Letters of Satisfactory Completion to enrollees who have their courses administered by their own Command.

WHEN THE COURSE IS ADMINISTERED BY THE NAVAL EDUCATION AND TRAINING PROGRAM DEVELOPMENT CENTER

Adhere as closely as possible to a schedule of completing at least one assignment per month; however, retain all the answer sheets until you have completed the course, then mail them to the Center. The Center will verify and record your scores. Remember that unnecessary delay in completing the course may, if you are a Reservist, prevent you from earning enough retirement credits to complete a year of Satisfactory Federal Service. Reservists may submit their answer sheets upon completion of a creditable unit.

Answer sheets are not returned by the Center, but you will receive formal notification of your final grade for the course (or creditable unit of the course) by issuance of a Letter of Satisfactory Completion. To ensure you receive credit for the course, complete the appropriate form included at the end of this course showing the address to which your Letter of Satisfactory Completion should be sent. This form should be mailed to the Naval Education and Training Program Development Center, Ellyson, Pensacola, Florida (32559) along with any additional training material which has been included. Retain the Rate Training Manual which is bound in the same cover with this course.

Fill in all blanks on the answer sheet. Unless you supply all the information required it will be impossible to give you credit for your work.

WHEN PREPARING FOR YOUR ADVANCEMENT EXAMINATION

Your examination for advancement will be based on the latest edition of the Manual of Qualifications for Advancement (NAVPERS 18068). It is possible that the qualifications for your rating may have changed since this nonresident career course and textbook were printed. Be sure to refer to the latest editions of NAVPERS 18068 and NAVEDTRA 10052 when preparing for your examination.

The study suggestions in this nonresident career course, in the Rate Training Manual, and in the current edition of Bibliography for Advancement Study (NAVEDTRA 10052) are intended to help you locate study materials on which the examination will be based. The qualifications for advancement and the appropriate assignments of the nonresident career course in which the qualifications have been covered are included as an appendix to the textbook.

NAVAL RESERVE RETIREMENT

This course is evaluated at 16 Naval Reserve retirement points. These points are creditable to personnel eligible to receive them under current directives governing retirement of Naval Reserve personnel. NOTE: This course is a minor revision and Naval Reserve Retirement credit will not be given for this course if the student has previously received retirement credit for any Aviation Boatswain's Mate F 1 & C ECC or NRCC. Points will be credited in units as follows:

Unit 1: 12 points upon satisfactory completion of Assignments 1 through 6.
Unit 2: 4 points upon satisfactory completion of Assignments 7 and 8.

WHAT IS THE COURSE OBJECTIVE

While completing this course the student will demonstrate his understanding of course materials by correctly answering the items on the following: the enlisted rating structure; the advancement system; principles of leadership; organization and responsibilities of the fuels division ashore and afloat; the operation, inspection, and maintenance of the JP-5 system and its related components; protective systems and related safety devices; fueling and defueling operations; operation, inspection, and maintenance of the AvGas system and its related components; the aviation lube oil system; quality assurance and surveillance; damage control; and administrative procedures.

Naval nonresident career courses may include a variety of items -- multiple-choice, true-false, matching, etc. The items are not grouped by type; regardless of type, they are presented in the same general sequence as the textbook material upon which they are based. This presentation is designed to preserve continuity of thought, permitting step-by-step development of ideas. Some courses use many types of items, others only a few. The student can readily identify the type of each item (and the action required of him) through inspection of the samples given below.

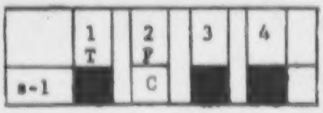
MULTIPLE-CHOICE ITEMS

Each item contains several alternatives, one of which provides the best answer to the item. Select the best alternative and erase the appropriate box on the answer sheet.

SAMPLE

s-1. The first person to be appointed Secretary of Defense under the National Security Act of 1947 was
   1. George Marshall
   2. James Forrestal
   3. Chester Nimitz
   4. William Halsey

The erasure of a "C" is indicated in this way on the answer sheet:



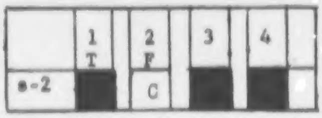
TRUE-FALSE ITEMS

Determine if the statement is true or false. If any part of the statement is false the statement is to be considered false. Erase the appropriate box on the answer sheet as indicated below.

SAMPLE

s-2. Any naval officer is authorized to correspond officially with a bureau of the Navy Department without his commanding officer's endorsement.

The erasure of a "C" is indicated in this way on the answer sheet:



MATCHING ITEMS

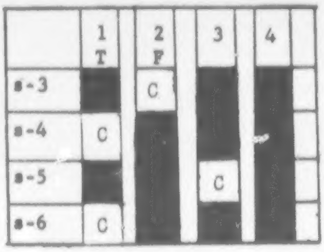
Each set of items consists of two columns, each listing words, phrases or sentences. The task is to select the item in column B which is the best match for the item in column A that is being considered. Specific instructions are given with each set of items. Select the numbers identifying the answers and erase the appropriate boxes on the answer sheet.

SAMPLE

In items s-3 through s-6, match the name of the shipboard officer in column A by selecting from column B the name of the department in which the officer functions.

A. Officers	B. Departments
s-3. Damage Control Assistant	1. Operations Department
s-4. CIC Officer	2. Engineering Department
s-5. Assistant for Disbursing	3. Supply Department
s-6. Communications Officer	

The erasure of a "C" is indicated in this way on the answer sheet:



NOTICE: If, on erasing, a page number appears, review text (starting on that page) and erase again until "C" appears. No points are earned for the item unless the "C" is uncovered. Follow directions exactly as on answer sheet.

While working on a nonresident career course, a student may refer freely to open-book texts and references. He may seek advice and instruction from others on problems arising in the course, but the solutions submitted must be the result of the student's own work and decisions. The student is prohibited from referring to or copying the solutions of others, or giving completed solutions to anyone else taking the same course. Noncompliance can result in suspension from the course by the administering activity and disciplinary action by the Chief of Naval Personnel.

Assignment 1

ABF Rating, Aviation Fuels Division Afloat, JP5 System Afloat

Text: Pages 1 - 30

In this course you will demonstrate that learning has taken place by correctly answering training items. The mere physical act of indicating a choice on an answer sheet is not in itself important; it is the mental achievement, in whatever form it may take, prior to the physical act that is important and toward which non-resident career course learning objectives are directed. The selection of the correct choice for a course training item indicates that you have fulfilled, at least in part, the stated objective(s).

The accomplishment of certain objectives, for example, a physical act such as drafting a memo, cannot readily be determined by means of objective type course items; however, you can demonstrate by means of answers to training items that you have acquired the requisite knowledge to perform the physical act. The accomplishment of certain other learning objectives, for example, the mental acts of comparing, recognizing, evaluating, choosing, selecting, etc., may be readily demonstrated in a course by indicating the correct answers to training items.

The comprehensive objective for this course has already been given. It states the purpose of the course in terms of what you will be able to do as you complete the course.

The detailed objectives in each assignment state what you should accomplish as you progress through the course. They may appear singly or in clusters of closely related objectives, as appropriate; they are followed by items which will enable you to indicate your accomplishment.

All objectives in this course are learning objectives and items are teaching items. They point out important things, they assist in learning, and they should enable you to do a better job for the Navy.

This self-study course is only one part of the total Navy training program; by its very nature it can take you only part of the way to a training goal. Practical experience, schools, selected reading, and the desire to accomplish are also necessary to round out a fully meaningful training program.

Learning Objective: Recognize the enlisted rating structure, duty assignments and responsibilities, and facts pertaining to advancement

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1-1. What ratings have been established in order that personnel may be properly utilized within the scope of a general rating where specialization is required?
   1. Service ratings
   2. Special ratings
   3. Emergency ratings
   4. All of the above

1-2. The general rating of Aviation Boatswain's Mate applies to which of the following pay grades?
   1. E-2 through E-9
   2. E-6 through E-8
   3. E-4 through E-9
   4. E-8 and E-9

1-3. A listing of special programs and projects pertinent to the ABF rating may be found in certain BUPERS Notices and the
   1. Enlisted Transfer Manual
   2. BUPERS Manual
   3. Bibliography for Advancement Study NAVEDTRA 10052 (Series)
   4. Manual of Qualifications for Advancement NAVPERS 18068 (Series)

1-4. The leadership qualities required of a senior ABF can be acquired only by
1. understanding leadership principles
2. studying leadership material
3. following the Navy Leadership Program
4. hard work and application of leadership principles

1-5. Critical self-evaluation can help a senior petty officer to improve the leadership traits in which he is weak.

1-6. Which of the following personal advantages, other than monetary, can be gained from advancement?
1. Greater pride
2. Higher morale
3. Feeling of accomplishment
4. All of the above

1-7. The senior ABF's worth to the Navy is judged in part on the quality of leadership he displays.

1-8. Which of the following must an ABF do to qualify for advancement?
1. Demonstrate his knowledge of the material in the pertinent Rate Training Manual
2. Demonstrate his ability to perform the pertinent practical requirements
3. Have a certain amount of time in grade and be recommended by his commanding officer
4. Meet all of the above requirements

1-9. What should you tell personnel assigned to you concerning advancement?
1. Eligibility for advancement amounts to actual promotion once all training requirements are met
2. A good training record and a high written examination score are sufficient to ensure advancement
3. Advancement in rating is automatic if satisfactory training progress is made
4. Promotion quotas, written examination score, length of service, and performance marks all affect advancement possibilities

1-10. After an ABF has performed the work of his rate satisfactorily for the required length of time and has made a passing score on his written examination, he is automatically advanced to ABFC.

1-11. What publication gives the minimum requirements for advancement?
1. Military Requirements for PO 1 & C, NAVEDTRA 10057 (Series)
2. Bibliography for Advancement Study, NAVEDTRA 10052 (Series)
3. Manual of Qualifications for Advancement, NAVPERS 18068 (Series)
4. List of Training Manuals and Correspondence Courses, NAVEDTRA 10061 (Series)

1-12. Which of the following statements regarding the "Quals" Manual is correct?
1. It is issued annually by the Bureau of Naval Personnel
2. It covers only the professional requirements for personnel advancement
3. It lists qualifications for general ratings but not for service ratings
4. It covers both military and professional requirements for advancement in all rates and ratings

1-13. The professional requirements for the ABF1 and ABFC rates are given in the "Quals" Manual as
1. knowledge factors and examination subjects
2. practical factors and military factors
3. practical factors and knowledge factors
4. examination subjects and military factors

1-14. Why should a man preparing for advancement carefully examine the "Quals" Manual rather than the "quals" listed elsewhere?
1. Because the material from other sources might list only the examination subjects, while the "Quals" Manual lists both the examination subjects and practical factors
2. Because the material from other sources will show what a man is expected to know if he wants to pass the rating exam, but the "Quals" Manual also shows what he should already know
3. Because any changes to the qualifications for advancement will be found in the "Quals" Manual and might not be included in other sources
4. For all of the above reasons

1-15. For advancement, enlisted personnel in any paygrade need to demonstrate proficiency in the qualifications specified for the next higher pay grade, and may be required to demonstrate qualifications for all lower paygrades.

1-16. The basis for questions in the written advancement examination is formed by the
1. knowledge factors of the military and professional qualifications
2. practical factors of the military and professional qualifications
3. knowledge and practical factors of the professional qualifications
4. knowledge factors and practical factors of the military and professional qualifications

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Learning Objective: Determine procedures applicable to the Record of Practical Factors NAVEDTRA Form 1414/1.

1-17. What entries should be made on your Record of Practical Factors NAVEDTRA Form 1414/1

1. Skills listed as minimum requirements for the ABF rating
2. Skills closely related to the ABF rating but which are not listed as minimum skill requirements
3. Additional changes to the ABF rating qualifications
4. All of the above

1-18. What action should you take when you are transferred from one activity to another?

1. Request a statement concerning your qualifications from the activity you are leaving
2. Secure your NAVEDTRA Form 1414/1, take it to your new commanding officer
3. Inform your new division chief that you have completed your practical factors
4. Ensure your NAVEDTRA Form 1414/1 is up-to-date and is in your service record

1-19. A NAVEDTRA Form 1414/1 is used to record satisfactory performance of the practical factors by each man in which pay grades?

1. E-1 through E-9
2. E-3 through E-8
3. E-4 through E-8
4. E-4 through E-9

Learning Objective: Identify the types, issuance, contents, and uses of publications required for advancement.

1-20. Which of the following is most inclusive regarding material which should be studied by an ABF preparing for the Navy-wide advancement examination?

1. The mandatory and recommended reference materials listed in Bibliography for Advancement Study NAVEDTRA 10052 (Series)
2. The subjects covered in the "Quals" Manual under knowledge factors
3. The mandatory reference materials only listed in the Bibliography for Advancement Study NAVEDTRA 10052 (Series)
4. Publications related to the professional aspects of the rating and those related to military requirements

1-21. How often is NAVEDTRA 10052 issued in revised form?

1. Quarterly
2. Annually
3. Semiannually
4. As required by changes

1-22. What is the requirement for completing a mandatory Rate Training Manual marked with an asterisk (*) in NAVEDTRA 10052?

1. Passing a locally prepared test
2. Passing the nonresident career course that is based on the designated training manual
3. Successful completion of the appropriate school
4. Any of the above

1-23. **The recommended study references in NAVEDTRA 10052 are supplementary and the student need not spend much time on them as they are NOT used as source material for written examinations.**

1-24. Aviation Boatswain's Mate F 1 & C, NAVEDTRA 10304-C is a revision of the original Rate Training Manual.

1-25. The fundamental purpose of a Rate Training Manual is to

1. aid personnel to advance
2. offer advanced study to graduates of Navy schools
3. teach specific equipments to personnel in specific ratings
4. cover the professional and military aspects of specific rates

1-26. What is the first step you should take in starting your study of a Rate Training Manual?

1. Read the chapter headings
2. Outline the entire manual
3. Familiarize yourself with the entire manual
4. Prepare a list of questions to be answered as study progresses

1-27. The reason for including suggestions 4 and 7 in the list of study suggestions given in your textbook is that in following them you

1. are able to peg each subject to an individual qualification as given in the "Quals" Manual
2. familiarize yourself with the aims and contents of the manual and relate the subject area to your past experience, thereby creating an excellent learning situation
3. write an outline of the manual which will be a valuable reference for future study
4. are able to separate the military qualifications from the professional qualifications in the manual

1-28. Why is the use of nonresident career courses encouraged?
1. Because an idea of how much you have learned from a training manual can be obtained by taking the course
2. Because these courses assist you in mastering training manual information
3. Because mandatory Rate Training Manuals can be completed by passing the courses
4. Because of all of the above

Learning Objective: Recognize methods of developing leadership qualities and duties relating to the training of others.

1-29. An important quality that must be developed as you advance is your ability to
1. impress others with your job knowledge
2. read technical material
3. speak and write in a manner understandable by others
4. write detailed, complete instructions concerning work procedures

1-30. If you have been promoted to ABFC, which title is most inclusive of the traits you should possess?
1. Counselor
2. Leader
3. Administrative technician
4. Disciplinarian

1-31. As a senior petty officer, your authority and that of all officers rests upon the
1. position occupied
2. leadership qualities exhibited
3. degree of your specialized knowledge and skill
4. authority conferred by the commanding officer

1-32. Which of the following statements is most applicable to the training of subordinates in technical and military subjects by senior petty officers?
1. Training is conducted any time maintenance is to be performed
2. Training is conducted whenever and wherever a group of subordinates can be assembled for classroom-type instruction
3. Training is conducted by formal and informal sessions to qualify personnel for advancement
4. Training is conducted by holding formal or informal sessions during idle periods when no work can be accomplished

1-33. Why should a senior ABF correct the terminology of a junior ABF who constantly refers to jet fuel as gasoline?
1. Because such technical ignorance should be corrected before the individual may be advanced
2. Because the principles of good training require that a senior petty officer insist upon the use of proper technical terms by his subordinates
3. Because failure to use proper terminology shows an unfamiliarity with the subject and places the individual at a disadvantage in communications which involve the subject
4. Because of all of the above

1-34. A well-planned training program using NAVEDTRA 1414/1 as a curriculum guide should be conducted so that each student will be
1. interested in the program
2. given an opportunity to lecture about his particular job
3. qualified as an instructor by the end of the training period
4. thoroughly qualified for the next higher rate by the time he is eligible for advancement

1-35. In planning long-range on-the-job training programs, senior ABFs should attempt to
1. emphasize study of theory instead of practice
2. emphasize specialization
3. broaden the specialized knowledge and skill of their men
4. make adequate allowance for trial-and-error learning

1-36. As an ABF advances, it is important that he become more familiar with the work of other ratings and the mission of the command so that he can direct the work of his group for maximum benefit of the organization.

1-37. If you should hear about anything new concerning the operation and maintenance of aircraft fueling equipment, you should find out everything you can about it because, as a senior petty officer, it is imperative that you keep yourself informed of new changes and developments that affect you or your work.

1-38. How may a senior petty officer be sure that he is getting the latest professional information needed for training his men for advancement?
1. By utilizing films listed in the current U. S. Navy Film Catalog, NAVAIR 10-1-777
2. By utilizing the latest edition and/or revision of publications
3. By ensuring that all official changes have been inserted in the professional publications, requiring change insertion
4. By all of the above means

Learning Objective: Recognize paths of and requirements for advancement to Senior Chief, Master Chief, Warrant Officer, and Commissioned Officer.

1-39. Special paths of advancement to Senior and Master Chief, Warrant Officer, and Commissioned Officer are open to personnel who demonstrate which of the following qualities?
1. The highest order of leadership and military responsibility
2. Outstanding professional ability
3. Unquestionable moral integrity
4. All of the above

1-40. Which of the following commands is responsible for determining which ratings receive additional pay?
1. SECNAV
2. CNO
3. BUPERS
4. Local command

1-41. What is the final requirement for promotion to ABCS and ABCM?
1. Successful completion of the Navy-wide examination
2. Recommendation by the commanding officer
3. Selection by a regularly convened board
4. Demonstrated qualities of leadership

1-42. What is the lowest rate level in which enlisted personnel may apply for advancement to Warrant Officer (W-1)?
1. E-5
2. E-6
3. E-7
4. E-8

1-43. ABFs selected for the Warrant Officer program are no longer required to pass the fleet-wide examination for Chief Petty Officer.

Learning Objective: Relative to aviation fuels (V-4) divisions afloat, recognize organizational requirements and the responsibilities and duties of personnel assigned.

1-44. Regardless of the type of ship, or the type of aircraft embarked, the basic mission and basic structure of the V-4 division does NOT change.

1-45. When aviation fuel replenishment is completed, to whom does the aviation fuel officer report the quantity received?
1. The supply officer
2. The officer-of-the-deck
3. The aircraft maintenance officer
4. Both 1 and 2 above

In items 1-46 through 1-50, select from column B the petty officer who is responsible for each duty listed in column A.

A. Duties

1-46. Maintains the training program

1-47. Maintains safety, testing, and emergency equipment in proper working condition

1-48. Ensures that the AvFuel watch-standers understand the importance of their watch

1-49. Conducts the daily division muster and reports the results to the division officer

1-50. Assists in the preparation of division personnel evaluation sheets

B. Petty Officers

1. Leading Chief
2. Leading PO
3. Police PO
4. Repair team PO

1-51. Who acts as aviation fuels control supervisor during the receipt, transfer, and discharge of all aviation fuels?
1. The leading PO
2. The below decks PO
3. The flight deck PO
4. The leading chief

1-52. Before any operations involving the handling of aviation fuel or making repairs to any of its equipment, the aviation fuels flight deck PO or hangar deck PO will request the officer-of-the-deck to have the "smoking lamp" put out.

1-53. Ensuring that all safety precautions and orders, including the checking of safety shields on flange joints in machinery spaces, are complied with is the responsibility of the
1. repair petty officer
2. lube oil petty officer
3. AvGas and JP-5 petty officers
4. aviation fuels flight and hangar deck petty officers

1-54. ABF3s or ABF2s generally fill which of the following key billets in the division?
1. Quality assurance petty officer
2. Damage control petty officer
3. Police petty officer
4. All of the above

1-55. Who is responsible for the security of the AvFuels system when the ship is NOT at flight quarters?
1. The safety petty officer
2. The AvGas and JP-5 petty officer
3. The aviation fuels security watch
4. The aviation fuels flight and hangar deck petty officer

Learning Objective: Recognize the development of aviation fuel systems afloat from early AvGas systems, through jet mix and interim systems, to present JP-5 systems.

1-56. What established the required head of pressure for the aviation gasoline stowage tanks and controlled the limit of that pressure in the original high-capacity aviation gasoline systems?
1. A gravity tank
2. Four 600-gpm sea water pumps
3. Four 675-gpm aviation gasoline boost pumps
4. An elevated loop in the overboard discharge

1-57. Why was the jet mix aboard aircraft carriers brought about?
1. Because of the need for enough aircraft fuel stowage space for around-the-clock operations of the jet aircraft
2. Because of the lack of protected stowage capacity aboard carriers for both the 115/145 aviation gasoline and the JP-3 and JP-4
3. Because of the development of JP-5 fuel
4. Because of all of the above

1-58. What features in the different types of JP-5 fueling systems aboard aircraft carriers are practically identical?
1. Pumps and filters
2. Type and number of components
3. Design and operational procedures
4. Type and location of components

Learning Objective: Recognize types, components, or functions of primary JP-5 pumping systems, and identify associated pumps and pump-operating principles

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1-59. The filters and purifers used in the JP-5 transfer system operate at a flow rate of
1. 200 gpm
2. 300 gpm and 200 gpm, respectively
3. 300 gpm
4. 400 gpm

1-60. Of the various pumping systems within the JP-5 fuel system, which one differs most from ship to ship?
1. Filling system
2. Service system
3. Stripping system
4. Transfer system

1-61. The most common service pump used in the JP-5 system aboard ship is the centrifugal type.

1-62. Which of the following is located in the quadrant distribution riser of all CVAs?
1. Transfer pump
2. Sparling flowmeter
3. Pressure regulator
4. Service fuel filter

Learning Objective: Relative to shipboard JP-5 tanks, recognize types, locations, components, operating characteristics, and maintenance functions.

In items 1-63 through 1-66, select from column B the tank that is associated with each statement in column A.

A. Statements

1-63. The top of the tank is at the fourth deck level, and the bottom is the shell of the ship

1-64. The shell of the ship forms two sides and bottom of each tank

1-65. The tanks are shallow

1-66. The tanks are an integral part of the ship's underwater protective system

B. Tanks

1. Peak
2. Deep centerline
3. Wing
4. Double bottom

In items 1-67 through 1-70, select from column B the stowage tank component which serves each purpose listed in column A.

A. Purposes

1-67. Prevents high pressure from rupturing the stowage tank if overfilled

1-68. Used for detecting water in stowage tanks

1-69. Reduces turbulence when filling stowage tanks

1-70. Used for ballasting and and deballasting stowage tanks

B. Components

1. Sounding tubes
2. Overflow line
3. Stripping tailpipe
4. Nonvortex belled-mouth fitting and splash plate

1-71. Where does the overflow go when the overflow tanks are full?
1. Overboard
2. To the emergency tanks
3. To another nest of stowage tanks
4. To any of the above, depending on the type carrier

1-72. Which of the following statements best describe the purpose of the amidship emergency tanks?
1. Emergency issue of JP-5 to the engineering department
2. Fuel may be used for issue only in case of an emergency
3. Fuel is transferred into the emergency tanks if problems arise with normal stowage tanks
4. The emergency tanks are maintained full of fuel to provide an underwater protective system for the ship's main engine rooms

1-73. What is the primary function of the motor-driven stripping system in the service tanks?
1. To remove the sea water used for ballasting the tanks
2. To remove all water and solids from the bottoms of the tanks
3. To completely empty the tanks and to remove the wash water after cleaning
4. To empty the transfer filter and/or purifier water drain box

1-74. When may personnel enter into a JP-5 tank to inspect it?
1. After the tank has been flushed with sea water three times
2. After six months have elapsed since the last inspection
3. Only after all safety precautions specified by the gas-free engineer have been observed
4. After all of the above have taken place

1-75. Service tanks are cleaned with
1. steam and solvent-emulsifier-type compounds
2. salt water
3. fresh water
4. fresh water and detergent

Assignment 2

JP-5 System Afloat

Text: Pages 30 - 68

Learning Objective: Identify types and operating principles of liquid level indicators currently used with JP-5 tanks aboard ship.

● Items 2-1 through 2-16 refer to liquid level indicators.

2-1. Liquid level indicators which weigh the fuel in the tank and give a readout in gallons are frictionless-balance and, because they have no moving parts, retain their accuracy over years of use.

2-2. Why is the "U" tube an optimum pressure-measuring device?
1. Because it contains no mechanical parts
2. Because the reading is not affected by temperature
3. Because the scale is graduated in feet and inches
4. Because of both 1 and 2 above

2-3. What is the correct sequence of pressure transmission in the liquid level indicators?
1. Hydrostatic head → equalizer line → air trapped in the tank downpipe → indicating liquid in well → glass gage
2. Hydrostatic head → air trapped in the tank downline → equalizer line → indicating liquid in well → glass gage
3. Hydrostatic head → air trapped in the tank downpipe → pressure line → indicating liquid in well → glass gage
4. Pressure line → hydrostatic head → air trapped in tank downpipe → indicating liquid in well → glass gage

● Item 2-4 through 2-11, refer to the hand pump model.

2-4. What function is served by the hand pump used in the three-tube system?
1. It equalizes the pressure in the "U" tube
2. It pressurizes the equalizer line to maintain balanced pressure on the glass gage
3. It forces the JP-5 out of the tank downpipe and provides the air between the JP-5 and the indicating liquid in the well
4. It does all of the above

2-5. What indicating liquid is used in the "U" tube if the tank has a depth of 14 feet?
1. Mercury
2. No. 294 Red Liquid
3. No. 120 Green Liquid
4. No. 100 Red Liquid

2-6. Refer to figure 3-12 in your textbook. Which of the following air lines transmit(s) static head pressure of the JP-5 in the tank downpipe to the indicating liquid?
1. Equalizer line
2. Pump line
3. Pressure line
4. Both 1 and 2 above

2-7. When the hand pump is in use, what indication will be observed when all the liquid is out of the tank downpipe?
1. The liquid in the glass will drop rapidly
2. The liquid in the glass will drop rapidly, and two consecutive equal readings will be obtained
3. The liquid in the glass will rise rapidly
4. The liquid in the glass will no longer rise rapidly

Items 2-8 through 2-11 relate to indications of liquid in the gage glass. Select from column B the observed indication caused by each condition listed in column A.

	A. Conditions		B. Observations
2-8.	Too much liquid in the reservoir	1.	Liquid drops in the glass when air lines are disconnected
2-9.	Tubes blocked	2.	Liquid does not drop or remains above first calibration
2-10.	Too little liquid in the reservoir	3.	Liquid falls below first calibration
2-11.	Air leak in the system	4.	Liquid will not stay up after hand pump is used

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Items 2-12 through 2-15 refer to the compressed air model (Two-Tube System).

2-12. What means is provided for accurately reducing the ship's low-pressure air to 45 psi?
1. The duo-snubber and needle valve
2. The duo-snubber and pressure gage
3. The reducing valve and duo-snubber
4. The reducing valve and pressure gage

2-13. What component prevents a loss of air out of the system in the event the low-pressure air supply is cut off?
1. Rotometer
2. Snubber valve
3. Vent check valve
4. Air check valve assembly

2-14. In the compressed air model liquid indicator, 45 psi is used to purge the system and 5 psi to operate the system.

2-15. One way in which the one-tube system differs from the two-tube system is that the one-tube system does NOT have an equalizer line.

2-16. Of the following statements concerning the Gems Tank Level Indicating (TLI) System, which one is NOT correct?
1. The transmitter located inside the tank is mounted vertically
2. The Gems system utilizes electrical current to indicate liquid level
3. The magnet-equipped float is connected to the receiver by means of the cable system
4. The transmitter is connected to the receiver by means of the cable system

2-17. Regardless of the size or shape of the tank being gaged, the Gems (TLI) system requires only one transmitter.

2-18. The tap switches located inside the transmitter of the Gems (TLI) system are actuated by the
1. primary reciever
2. transmitter
3. magnet-equipped float
4. secondary receiver

2-19. Because of the tap switch arrangement, how much movement of the float is required to effect a change in the meter reading?
1. 1/2-in.
2. 1/3-in.
3. 1/4-in.
4. 1/8-in.

In items 2-20 through 2-23 select from column B the receiver housing which contains the components listed in column A.

	A. Components		B. Housings
2-20.	Power supply	1.	Primary receiver
2-21.	Indicating meter	2.	Secondary receiver
2-22.	Slosh dampening control	3.	Both primary and secondary receivers
2-23.	Alarm controls		

2-24. Even though electrical current flows through the transmitter (located inside the tank), this system is considered safe because the
1. meter is connected through a series resistance to the transmitter
2. current is too low to cause an explosion
3. transmitter is a sealed unit which makes it explosion proof
4. cable system which carries the electrical current does not come in contact with the fuel

In items 2-25 through 2-28 select from column B the component that performs each of the actions listed in column A.

A. Actions	B. Components
2-25. Checks the continuity of cables from transmitter to receiver	1. SENS-PAK unit 2. Electrical slosh dampener
2-26. Prevents meter fluctuation	3. Calibrate potentiometer
2-27. Provides 10 volts dc across the voltage divider and cabling	
2-28. Initiates an alarm to indicate a predetermined condition	

2-29. Changes in a fuel's specific gravity must be compensated for by manually turning an adjustment of the primary receiver.

Learning Objective: Identify uses, components, and operation of representative shipboard JP-5 filling and transfer systems.

● Items 2-31 through 2-46 refer to the filling and transfer piping and valve arrangement.

2-30. Which of the following is a primary use of the filling and transfer system?
1. Shifting fuel to trim the ship
2. Directing fuel from the forward independent defueling main to a preselected stowage tank
3. Receiving fuel into stowage tanks
4. Any of the above

2-31. The combined quick release (Robb) coupling is used to replenish aviation gasoline. What material is used in its construction?
1. Steel
2. Bronze
3. Brass
4. Aluminum

2-32. What holds the valve closed in the female end of the Robb quick-release coupling and valve?
1. A ring-shaped actuating cam
2. Protruding valve discs
3. A compression spring
4. All of the above, combined

2-33. What locks the Robb quick-release coupling in place when fueling?
1. A compressed spring
2. Released pressure on the ball race
3. Ball bearings forced into the male end
4. The slipping of the female end over the male end until the male end bottoms

2-34. What prompted the development of the probe fueling system?
1. The increase in hose size
2. The increase in delivery rate
3. The difficulty and time consumed in connecting and disconnecting hose lines
4. All of the above

2-35. Which of the following can be considered an advantage of the probe fueling system over the Robb unit?
1. The probe unit can be used with the fueling robb
2. It requires no handling by personnel during hookup or breakaway
3. Both 1 and 2 above
4. It provides a slower rate of fuel transfer

2-36. In the event an emergency breakaway is required during a refueling operation, who effects the breakaway?
1. The senior ABF at the refueling station
2. The receiving ship
3. The delivery ship
4. Either 2 or 3 above

2-37. The ship's diesel oil day ready service tank can be serviced from the JP-5 system.

2-33. The double-valved manifold serves which of the following purposes?
1. It connects the Cla-Val service stations to the pump room
2. It controls the flow of JP-5 to the stowage tanks that are designated stowage or ballast
3. It gives double protection against contaminating the transfer main when the stowage tanks are filled with sea water
4. It does both 2 and 3 above

2-39. Telltale valves installed on the front side of the transfer mainside valves are used for what purpose(s)?
1. To determine the valve seat condition of the transfer mainside valves
2. To determine the valve seat condition of the tankside valve
3. To drain the header for valve maintenance
4. To accomplish both 1 and 2 above

2-40. Which of the following statements concerning manifolds is correct?
1. The single-valved manifolds use 8" gate valves
2. The valve holes in the header are 8" in diameter
3. An 8" nozzle connects the valves in both the single-valved and double-valved manifolds
4. Single-valved manifolds are not used with tanks that are ballasted

2-41. Refer to figure 3-21 in your textbook. Which of the following pump and purifier alignments is impossible?
1. No. 1 pump aligned with No. 1 purifier, and No. 2 pump aligned with No. 2 purifier
2. No. 1 pump aligned with No. 1 purifier, and No. 3 pump aligned with No. 2 purifier
3. No. 2 pump aligned with No. 1 purifier, and No. 3 pump aligned with No. 2 purifier
4. No. 2 pump aligned with No. 2 purifier, and No. 3 pump aligned with No. 1 purifier

2-42. When the centrifugal purifier is operated, how many transfer pumps are used for each purifier?
1. One
2. Two
3. Three
4. Four

2-43. What function(s) is/are performed by the globe valves associated with the centrifugal purifier?
1. One throttles the inlet pressure to 9 psi; the other controls the discharge pressure at 30 psi
2. One is used as a crossover valve; the other is used as a discharge valve
3. They direct fuel to and from the bypass line
4. They control the fuel flow through the purifier at 200 gpm

2-44. Purifiers are used only when the
1. stowage tanks have been ballasted with sea water
2. JP-5 in the stowage tanks is below the common suction header
3. service tanks are filled
4. service tanks have been ballasted with sea water

2-45. The interconnection between the suction and and discharge headers of the service and transfer pumps permits the service pump to be used as a transfer pump.

Learning Objective: Identify components and operation of representative shipboard JP-5 stripping systems.

2-46. Refer to figure 3-22 in your textbook. What is the correct flow of fuel when JP-5 service tanks are emptied for cleaning?
1. Service tank stripping tailpipe → single valve manifold → stripping suction main → gate valve → stripping pump suction header → stripping pump inlet line → gate valve → stripping pump → globe stop check valve → one-way valve → common discharge header gate valve → transfer main
2. Service tank stripping tailpipe → one-way check valve → gate valve common suction header → pump inlet piping gate valve → stripping pump → globe stop check valve → discharge piping → one-way check valve → common discharge header → gate valve → transfer piping
3. Service tank stripping tailpipe → single valve manifold → one-way check valve → gate valve → stripping pump suction header → gate valve → stripping pump → globe stop check valve → one-way check valve → stripping pump discharge header → gate valve → transfer main
4. Stowage tank stripping tailpipe → single valve manifold → common suction header → pump inlet piping → gate valve → stripping pump → globe stop check valve → one-way valve → common discharge header → gate valve → transfer line

● Items 2-47 through 2-50 refer to the stripping system.

2-47. The flood and drain manifolds are used in the JP-5 stripping system in conjunction with which tanks?
1. Service tanks
2. Emergency tanks
3. Stowage tanks that are ballasted
4. All of the above

2-48. What restricts the flood and drain manifold to performing only one operation at a time?
1. A cutout valve
2. The valve arrangement
3. A globe stop check valve
4. A sliding locking bar assembly

2-49. Water and solids are removed from the bottom of the service tanks by
1. filters
2. purifiers
3. hand-operated stripping pumps
4. motor-operated stripping pumps

2-50. Which statement is correct concerning the stripping system utilized for service tanks?
1. The service tanks have two separate stripping systems
2. The motor-driven stripping line terminates 1 1/2 inches from the tank bottom
3. The hand operated stripping line terminates 3/4 inch from the tank bottom
4. The service tanks use only the hand-operated stripping system.

Learning Objective: Identify components and operation of representative shipboard JP-5 service systems, including both Blackmer and Cla-Val service stations.

2-51. Refer to figure 3-26 in your textbook. In an emergency, what arrangement allows two of the service pumps to be used as transfer pumps while the other two are being used as service pumps?
1. Crossover valves in the common suction header and a cross-connection from the transfer pump suction header
2. Crossover valves in the discharge header and a cross-connection from the transfer pump discharge header
3. Crossover valves in the transfer suction header and a cross-connection from the common suction header
4. Both 1 and 2 above

● Items 2-52 and 2-53 refer to the service system piping and valves.

2-52. What function is served by the fluid flowing through the recirculating line?
1. It relieves excess pressure
2. It controls the pressure
3. It keeps the pump cool
4. It does all of the above

2-53. Which of the following safety devices can deenergize the pump controller in case of a malfunction?
1. A timing switch
2. A pressure-operated switch
3. Overload and low-voltage trip switches
4. Any of the above

2-54. On what principle do the priming pumps operate?
1. Centrifugal
2. Water piston
3. Constant displacement
4. Variable displacement

2-55. What regulates the flow of clean fresh water to the priming pumps?
1. A one-way check valve in the pump suction line
2. A globe-type valve in the common suction header
3. A "Y" type strainer and a 1/16-inch orifice in the seal suction line
4. All of the above

2-56. What prevents the discharge pressure from damaging the copper float when the pump is started?
1. Closing of the globe-type shutoff valve at the top of the discharge compartment
2. Using three lines from the top of the uppermost part of the pump casing
3. The vacuum suction header
4. The one-way check valve

● Items 2-57 through 2-66 refer to the Blackmer service system piping.

2-57. The quadrant distribution riser is located between the
1. fourth-deck riser valve and the filter crossover
2. service pump discharge header and the service stations
3. outboard main and the Blackmer fueling unit
4. filter bypass and the outboard main

2-58. For the Blackmer service stations to function properly, the pressure should be
1. between 5 psi and 20 psi
2. between 22 psi and 30 psi
3. 35 psi
4. 50 psi

2-59. Constant pressure in the system is controlled by the
1. venturi recirculating line
2. automatic pressure-regulating valve
3. fourth-deck riser valve
4. fourth-deck quadrant crossover lines

2-60. Where are the main fuel filters on a CVA located?
1. In the pump room
2. In the risers at the third-deck level
3. Upstream from the service pumps
4. At both 2 and 3 above

2-61. What function(s) is/are performed by the filtering media?

1. They automatically drain water from the filter sump
2. They remove more than 99.9 percent of the entrained water and 98 percent of solids 5 microns or larger
3. The coalescing elements remove solids and cause entrained water to form droplets which fall out of the fuel by gravity; the separator elements repel water and filter out micron particles
4. All of the above

2-62. To determine the pressure drop across the filter element, where are pressure gages installed?

1. On the inlet section of the filter
2. On the outlet section of the filter
3. On the fallout section
4. On all of the above

2-63. You must steam JP-5 filters prior to replacing their elements.

2-64. What enables any service station to be supplied from either the port or the starboard filter?

1. Service station risers coming off the crossover line
2. Service station risers coming off the bypass line
3. A crossover line fitted with a shutoff valve at each end
4. A bypass line fitted with a shutoff valve at each end

2-65. How is the entire port side of the ship pressurized by either the forward or after pump room?

1. By properly aligning the service header isolation valves
2. By properly aligning the outboard distribution main crossover valves
3. When necessary by opening the crossover valves in the pump room
4. When necessary, by unlocking the shutoff valves in the filter room

2-66. Before a Blackmer service station is started, the entire quadrant distribution system is vented by

1. the overboard distribution piping
2. a valved venting connection in the service station being used
3. the service system piping installed outboard along the ship's side
4. a valved venting connection in the most remote service station riser

- **Items** 2-67 and 2-68 refer to the Blackmer service station.

2-67. What holds the four-way valve in the fuel position?

1. An energized solenoid and the pawl
2. A deenergized solenoid and the pawl
3. The external valve handle being raised 90°
4. The external valve handle being lowered 90°

2-68. What will cause the four-way valve to return to the defuel position?

1. Opening the toggle switch on the hose nozzle
2. A break in the electrical ground to the aircraft
3. An interruption of the low-voltage current through the fueling hose
4. Any of the above

2-69. How does the Cla-Val system differ from the Blackmer system?

1. The Cla-Val system uses two gages on the vertical filter
2. The Cla-Val system uses gate valves throughout
3. The Cla-Val system has no pressure regulating system installed in the JP-5 quadrants
4. The Cla-Val system differs from the Blackmer system in all of the above ways

2-70. How is the defueling pump kept cool when defueling operations are NOT in progress?

1. By an orifice in the defueling pump
2. By a recirculation line to the defueling pump
3. By a 5-gpm flow from the distribution riser through the defueling pump
4. By a 5-gpm flow from the fueling station supply riser through the defueling pump

2-71. When a fueling operation is completed and the solenoid-operated pilot valve is deenergized, the high-pressure fuel closes the fuel valve, and the defuel valve opens and empties the hose.

2-72. Fuel defueled at the forward stations returns to the stowage tank via which components?

1. The downcomer and the fill and transfer piping
2. The downcomer, the forward defuel main, and the fill and transfer piping
3. The forward defuel main and the fill and transfer piping
4. Any of the above, depending on the system (CVA, LPD, LPH)

Learning Objective: Recognize requirements for CO_2 protective equipment in JP-5 systems and associated safeguards and maintenance practices.

2-73. What determines the type of CO_2 protective equipment installed on individual ships?

1. The type of fuel carried
2. The fuel capacity of the ship
3. The number of fueling stations aboard
4. The size and arrangement of the pumproom

2-74. Accidental discharge of CO_2, which may cause injury to personnel, is eliminated because two valves must be opened before CO_2 can be discharged.

2-75. What percentage of weight can a CO_2 fire extinguisher lose before it becomes necessary to have the cylinder refilled?

1. 5%
2. Between 5% and 10%
3. 10%
4. Any loss greater than 10%

Assignment 3

Operation of the JP-5 System; Gasoline Systems Afloat

Text: Pages 69 - 99

Learning Objective: Recognize the hazardous nature of fueling operations, requirements and procedures for receiving JP-5 at sea, and related ABF responsibilities, including emergency action.

3-1. The ABF is responsible for which of the following tasks during JP-5 replenishment at sea?
1. Procedures for receiving the JP-5 aboard
2. The filling connection hookup
3. Rigging the replenishment hose
4. Both 1 and 2 above

3-2. The greatest hazards are present when fueling operations are conducted while the ship is
1. underway
2. anchored
3. tied up
4. in drydock

3-3. What is the flashpoint of JP-5 fuel?
1. 130° F
2. 140° F
3. 150° F
4. 160° F

3-4. Prior to the replenishing operation, when should the stowage tanks be deballasted and stripped?
1. After damage control has provided a tank sequence table
2. After engineering has aligned the main drainage system and is standing by to operate the main eductors
3. As soon as possible after the confirmation of time and date for the replenishing operation
4. After all of the above conditions are met

3-5. What is the next operation following tank educting?
1. Filling
2. Trimming
3. Settling
4. Stripping

3-6. Tanks interconnected with one stripping manifold are stripped at the same time.

3-7. How is the actual content in a JP-5 tank determined?
1. By a sounding tape
2. By a sample
3. By a water-indicating paste
4. By all of the above

3-8. Since water turns the water-indicating paste red to the level of water in the tank, this reading in feet and inches, when converted to gallons and subtracted from the tank capacity, will give the quantity of JP-5 in the tank.

3-9. When is a composite sample taken?
1. When there is a no-water indication in the tank
2. When there is an indication of excessive water in the tank
3. When there is an indication of entrained water in the tank
4. When necessary to recheck either 1 or 2 above

3-10. What must be done before transferring or receiving fuel into a nest of tanks?
1. The service tanks must be deballasted
2. The overflow tank for that nest must be emptied
3. All slack service tanks must be topped off
4. All of the above must be done

3-11. Before fuel is received aboard, the JP-5 oil king must have knowledge of which of the following facts?
1. The amount of fuel already aboard and where it is located
2. The filling sequence
3. The approximate time it will take for refueling
4. All of the above

3-12. Knowledge of the filling sequence, which must be coordinated with damage control central so that proper trim and list of the ship can be maintained, will aid the one in charge when he makes which assignments?
1. The sounding teams
2. The manifold operators
3. The overboard discharge observers
4. All of the above

3-13. Which of the following factors involving the duration of the receiving operation may be determined by experience or by consulting the receiving log?
1. The amount of fuel to be received
2. The maximum receiving rate of the ship
3. The pumping rate of the tanker
4. Both 2 and 3 above

3-14. How many sound-powered telephone circuits are used during the receiving operation?
1. One
2. Two
3. Seven
4. Four

3-15. Which of the following personnel actions will bring about a more flexible division for conducting receiving operations?
1. The use of as many trainees as are available
2. Performance of actual duties by trainees
3. Rotation of experienced men to other stations during these operations
4. All of the above

In items 3-16 through 3-19, select from column B the officer who assumes each responsibility for ensuring maximum safety during the replenishment operations listed in column A.

A. Responsibilities

3-16. Controls the smoking lamp

3-17. Ensures that high-frequency electronic equipment is secured in the vicinity of the fueling stations

3-18. Ensures that unnecessary mobile equipment is not operated within 50 feet of the fueling station

3-19. Ensures that adequate fire main pumps are on the line and that the fog foam pumping unit is manned

B. Officers

1. Damage control watch officer
2. Operations watch officer
3. Aviation fuels officer
4. Officer of the deck

3-20. What will be the result, if any, if the valve disc guides in the female end of a quick-disconnect coupling break off?
1. The valve will leak
2. The flow through the valve will be partially restricted
3. The valve will not open
4. Any of the above may occur

3-21. When should the valve to the second nest of tanks be opened?
1. When the first nest of tanks is 80 percent full
2. When the first nest of tanks is 95 percent full
3. When the overflow tanks are 95 percent full
4. Any time the pressure is 40 psi

3-22. What percentage of the capacity of the overflow tanks must be allowed for fuel expansion due to normal temperature changes?
1. 2 percent
2. 5 percent
3. 20 percent
4. 25 percent

3-23. When is the "stop pumping" time given to the tanker?
1. When the overflow tanks have reached 80 percent of their capacity
2. When the tanks have reached 95 percent of their capacity
3. After the receiving rate at the carrier has been determined
4. When either 2 or 3 above occurs

3-24. Why are some stowage tanks on ships equipped with the Cla-Val service stations left empty?
1. For trim purposes
2. To receive the recirculated fuel
3. To receive the overflow fuel
4. For all of the above reasons

3-25. From the statements below, select the correct sequence of operations you must perform after the tanker has stopped pumping.
A. Close the valve in the quick-disconnect coupling
B. Blow the fuel in the hose back to the tanker by slowly admitting low pressure air at the filling connection
C. Close the filling connection gate valve at the hangar deck
D. Bleed the air out of the hose
E. Uncouple the hose and return it to the tanker
1. A, B, E, D, C
2. C, A, E, B, D
3. C, B, D, A, E
4. C, D, B, E, A

3-26. If a fuel sample fails to meet the cleanliness requirements during a refueling operation, who makes the final decision as to the acceptance or rejection of the fuel?

1. The commanding officer
2. The V-4 division officer
3. The V-4 division chief
4. The senior man at the refueling station

3-27. If you have to use a ten-pound sledge, a fire ax, and a spanner in an emergency breakaway, in which order should you use them?

1. Ten-pound sledge, spanner, fire ax
2. Fire ax, ten-pound sledge, spanner
3. Spanner, ten-pound sledge, fire ax
4. Fire ax, spanner, ten-pound sledge

Learning Objective: Identify procedures associated with stowage tank settling and stripping prior to JP-5 replenishment.

3-28. At the completion of the refueling operation, with whom does the order to release the span wire originate?

1. The delivery ship
2. The ship so designated prior to refueling
3. The receiving ship
4. Both 2 and 3 above

3-29. Prior to replenishing, what is the proper sequence for transferring fuel from the stowage tanks to the service tanks in a carrier having slack tanks?

1. Tanks with the longest settling time, overflow tanks, slack tanks
2. Tanks with the longest settling time, slack tanks, overflow tanks
3. Slack tanks, overflow tanks, tanks with the longest settling time
4. Overflow tanks, slack tanks, tanks with the longest settling time

3-30. Stowage tanks are always stripped weekly whether the carrier is at sea or in port.

3-31. Select the proper sequence in which the following valves are opened prior to starting the stowage tank stripping pumps.

A. Stripping main valves to the stripping pump suction header
B. Flood and drain manifold valve to the stripping main
C. Single-valved stripping manifold valve to the tank to be stripped
D. Stripping pump discharge valve
E. Cutout valve from discharge header to contaminated JP-5 settling tank
F. Stripping pump inlet valve

1. B, C, A, D, F, E
2. C, B, A, E, F, D
3. C, B, A, F, D, E
4. A, B, C, F, D, E

3-32. Approximately how much time must elapse after the stripping operation has started on the next stowage tank before a conclusive sample of JP-5 can be taken if the pipe capacity is 160 gallons and the pump capacity is 50 gpm?

1. Five minutes
2. Two minutes
3. Three minutes
4. Four minutes

3-33. The hand-operated stripping pump should be satisfactory for stripping the service tanks if the stowage tanks are given enough settling time, the stowage tanks are properly stripped, and the transfer filters are properly maintained and operated.

Learning Objective: Identify procedures associated with internal and external JP-5 transfer operations.

3-34. During the transfer operation, when is the purifier started?

1. After three minutes of operation
2. Before the transfer pump is started
3. Before the telltale valve is closed
4. After the inlet globe valve and throttle have maintained a pressure of 9 psi

3-35. During the transfer operation, which of the following entries is/are made in the log?

1. The time the purifier is started
2. The time the transfer pump is started
3. The result of the fuel sample analysis
4. All of the above

3-36. If a sample from the purifier is cloudy, which of the following actions must be taken?

1. The transfer operation must be secured
2. The stowage tanks on the line must be restripped
3. The centrifugal purifier must be inspected and discrepancies corrected
4. All the above actions must be taken

3-37. Which operating procedure is NOT required when transferring from one stowage tank to another?

1. Sounding
2. Stripping
3. Filtering
4. Emptying the overflow tanks

3-38. The motor-driven pump is used to consolidate the last 24 inches of fuel remaining in the stowage tanks. The pump's discharge header is aligned so that this fuel is discharged into the

1. transfer main
2. overflow tank
3. stripping tailpipes
4. contaminated JP-5 settling tank

3-39. How is the list and trim of the ship maintained during the ballasting operation?

1. By alternately filling the tanks on opposite sides of the ship
2. By using the tank filling sequence established by damage control central
3. By keeping a close watch on the liquid level indicators of the tanks being ballasted
4. By any of the above means

3-40. Select the correct sequence of flow when off-loading JP-5.

A. Service tank
B. Downcomer
C. Service pump discharge header
D. Transfer main
E. Transfer pump discharge header
F. Filling connection
G. Service pump

1. A, C, G, B, E, D, F
2. A, C, G, E, D, B, F
3. A, G, C, E, B, D, F
4. A, G, C, E, D, B, F

3-41. When off-loading JP-5, at least 4 stowage tanks must be on the line to prevent the service pump from losing suction.

Learning Objective: Identify procedures associated with flushing the JP-5 service system.

3-42. Which of the following occurrences requires flushing the entire JP-5 system?

1. Shipyard overhaul
2. Major rework on the JP-5 system
3. Draining back for long periods in port
4. Ballasting the JP-5 stowage tanks with sea water

3-43. Because the service system pumps large quantities of fuel at high pressure, which equipments must be checked prior to pumping?

1. Ventilation, pumping, and fire extinguishing
2. Pumping, communication, and fire extinguishing
3. Fire extinguishing, communication, and pressure regulating
4. Communication, fire extinguishing, and ventilation

3-44. Although all of the service pumps and service tanks are used sometime during the flushing operation, no more than one of each is used at any one time.

● Items 3-45 through 3-49 concern step one of the flushing operation which is accomplished by pumping from the forward service tanks to the aft stowage tanks.

3-45. Select the correct sequence of the following steps that you must take in aligning the system for the initial flushing operation:

A. Bypass the pressure regulators and main fuel filters and align the distribution piping between the forward and aft pumprooms
B. Open the valves from the transfer pump discharge header to the transfer main
C. Rotate the spectacle flange in the cross-connecting piping between the service and transfer pump headers
D. Open the cutout valves between the service pumps and tanks
E. Align the recirculating header to the first service tanks from which suction is to be taken
F. Open all pressure gage and sight glass gage valves
G. Open the pump recirculating lines
H. Strip all of the service tanks with hand pumps

1. A, B, C, F, G, D, E, H
2. H, F, D, G, E, A, C, B
3. H, F, G, D, E, B, C, A
4. F, C, H, D, A, G, E, B

3-46. By throttling the discharge valve on the service pump, you can control fuel pressure and flow for which of the following operations?
1. Ballasting and stripping
2. Internal transfer
3. The flushing operation
4. Any of the above

3-47. What is the correct sequence of fuel flow in the flushing operation?
1. Forward service tank → quadrant 2 distribution riser → cross-connecting piping in the outboard transfer main → after pumproom service pump discharge header → downcomer → transfer main → stowage tank
2. Forward service tank → crossover valves in the outboard distribution main → distribution riser in quadrant 2 → quadrant 4 distribution main → after pump room service pump discharge header → cross-connecting piping → transfer pump discharge header → stowage tank
3. Forward service tank → distribution riser in quadrant 2 → crossover valves in the outboard distribution main → quadrant 4 distribution riser → after pump room service pump discharge header → cross-connecting piping → transfer pump discharge header → stowage tank
4. Forward service tank tail pipe → service pump suction header → service pump → service pump discharge header → pressure regulator bypass → filter bypass → outboard distribution main forward downcomer → transfer main → stowage tank

3-48. From where are samples of JP-5 obtained during the flushing operation?
1. From a telltale valve in the double-valved manifold
2. From a test connection on the pressure fueling nozzle
3. From a sample connection installed in the after service pump discharge header
4. From both 2 and 3 above

3-49. After you have flushed the service system in the after pumproom, which statement is NOT correct concerning flushing the remaining sections of the outboard distribution main of quadrants 2 and 4?
1. Use the service pumps in the after pumproom when flushing the aft section of the outboard distribution main
2. Attach a pressure fueling nozzle to the venting hose
3. Attach the pressure fueling nozzle to the defueling main
4. Use one service pump for this flushing operation

● Items 3-50 and 3-51 concern step two of the flushing operation.

3-50. This step 2 is practically identical to which of the following?
1. Step 1
2. Fueling an aircraft
3. Defueling an aircraft
4. Both 1 and 2 above

3-51. Which of the following statements concerning the procedures you must use when setting up the pumproom is NOT correct?
1. Open the inlet and discharge valves to the pressure regulator
2. Open the inlet and discharge valves to the main fuel filter
3. Open the service station riser valve and the cutout valve to the hose reel
4. Open the inlet and discharge valves to the service pump

3-52. What must you do to remove air and vapor from the Blackmer service station?
1. Open the test connection on the pressure nozzle
2. Operate the service station in the defuel position
3. Slowly raise the operating handle on the 4-way valve
4. All of the above

Learning Objective: Recognize personnel, equipment, and procedures involved in fueling and defueling aircraft from the JP-5 service system.

In items 3-53 through 3-55, select from column B the member of the AvFuel crew that performs each duty involved in aircraft fueling listed in column A.

A. Duties

3-53. Maintains communications with flight deck control

3-54. Grounds the aircraft

3-55. Assists in handling the hose and attaches the nozzle to the aircraft

B. AvFuel Crew

1. Leader
2. Safety man
3. Nozzle operator
4. Service station operator

3-56. Which step is mandatory when the pressure fueling nozzle is connected to the aircraft?
1. The 4-way valve must be in the operating position
2. The Blackmer service station must be in operation
3. The hose must be charged with fuel
4. The nozzle must be fully locked on

3-57. When does the anticontamination sentry take a sample of fuel?
1. Before the aircraft is fueled
2. While the aircraft is being fueled
3. After the aircraft is fueled
4. When so directed by the AvFuel crew leader

3-58. All of the following are steps in securing the JP-5 service system EXCEPT closing the
1. pressure gage valve
2. pressure regulating recirculating line
3. service pump discharge valve
4. filter recirculating line

3-59. On the Blackmer fuel system, the correct hose connections to be used when defueling include a 1 1/2-inch hard rubber hose from the
1. aircraft to the defueling pump, and a collapsible hose from the defueling pump to the defueling main
2. defueling pump to the aircraft, and a 2 1/2-inch hard rubber hose from the defueling pump to the defueling main
3. defueling pump to the defueling main, and a 1 1/2-inch hard rubber hose from the aircraft to the defueling pump
4. defueling pump to the defueling main, and a 2 1/2-inch hard rubber hose from the aircraft to the defueling main

3-60. A pressure fueling nozzle with a short section of hard rubber hose attached to the nozzle is used for overwing defueling.

3-61. The Cla-Val fuel/defuel valve is used as a defuel valve only.

Learning Objective: Relative to the AvGas system afloat, identify the use, purpose, operation and/or description of pumps, tanks, gages, valves, diffusers, and cofferdams.

3-62. Which of the following statements is/are correct concerning the relationship between the AvGas pumps and the salt water pumps?
1. Salt water pumps are used to force AvGas to the inlet side of the AvGas pumps
2. When AvGas pumps are in operation there must be an equal number of salt water pumps operating
3. There is an equal number of both salt water and AvGas pumps
4. All of the above statements are correct

3-63. Relative to saddle-type stowage tanks, which statement best describes their purpose?
1. They have tanks located inside one another to save valuable space aboard ship
2. They provide the greatest possible safety for storing AvGas
3. They were designed to permit AvGas to float on salt water
4. They are surrounded by a cofferdam filled with nitrogen

In items 3-64 through 3-68, select from column B the type of AvGas tank described by each of the statements in column A.

	A. Statements	B. Tanks
3-64.	The recirculating header terminates at the midpoint of this tank	1. Inner
		2. Outer
3-65.	The sea water used to pressurize the tanks enters this tank	3. Drawoff
3-66.	The independent stripping system discharges into this tank	
3-67.	This tank has the largest capacity	
3-68.	This tank has the smallest capacity	

3-69. Which of the following statements is/are correct concerning the cofferdams?
1. The nitrogen is maintained in the cofferdam at 50% inertness, with a charging pressure of 1/2 psi
2. They are charged with nitrogen to reduce fire and explosion hazards
3. They serve as a void to collect any leakage from the stowage tank
4. All of the above statements are true

3-70. To prevent overcharging the cofferdam, a pressure relief valve is installed in the bypass line around the air escape riser. This valve is set to relieve at a pressure of
1. 1/2 psi
2. 2 psi
3. 6 psi
4. 4 psi

3-71. The unit installed within the AvGas tanks to distribute incoming fluid over a large area is known as the
1. diffuser
2. sluice pipe
3. baffle
4. eductor

In items 3-72 through 3-75, select from column B the gage which is referred to by each statement in column A.

	A. Statements		B. Gages
3-72.	This type is the oldest of the gages presently in use	1.	Static head liquid level
3-73.	This type gage is NOT used with the AvGas system	2.	Float actuated
3-74.	This gage is utilized in the cofferdam	3.	Magnetic actuated
3-75.	This gage utilizes the plane of cleavage		

Assignment 4

Gasoline Systems Afloat

Pages: Pages 99 - 133

Learning Objective: Relative to high-capacity aviation gasoline (AvGas) systems, recognize structural characteristics and operating principles, including locations and functions of system components.

4-1. **In the water-filled static head gasoline gage, what components are essential for gaging the tanks?**
1. The pressure-reducing valve, the flow indicator, and the differential pressure gage
2. The pressure-reducing valve, the sea-water pressure gage, and the differential pressure gage
3. The differential pressure gage, the flow indicator, and the upper and lower in-tank reservoirs
4. The differential pressure gage, the water-filled connecting lines, and the upper and lower in-tank reservoirs

4-2. What function is performed by the differential pressure gage?
1. It senses the differential pressure between the upper and lower in-tank reservoirs, and converts it into gallons of gasoline
2. It measures the differential pressure between the upper and lower in-tank reservoirs, and converts it into pounds of gasoline
3. It senses the differentential pressure between the inner and outer tank reservoirs, and converts it into gallons of gasoline
4. It measures the differential pressure between the inner and outer tank reservoirs, and converts it into pounds of gasoline

4-3. Damage to the bellows is prevented by
1. a flow limiter valve
2. a pressure-reducing valve
3. internal and external limiting stops
4. two vent valves on top of the manometer

In items 4-4 through 4-7, select from column B the gage component that performs each function listed in column A.

A. Functions	B. Components
4-4. To serve as a balancing agent for the gage	1. Bellows
4-5. To move in response to differential pressure	2. Torque tube
4-6. To give full scale deflection when the tank is full	3. Outer tank dial
4-7. To give a full indication when the tank is 95 percent full	

The multifunction selector is a unit that consists of eight sequence valves controlled by a rotating five-position handle (OFF, 1, 2, 3, 4). In items 4-8 through 4-11, select from column B the action performed when each handle position listed in column A is selected.

	A. Handle Positions	B. Actions
4-8.	1	1. The upper in-tank reservoir and connecting lines are filled with sea water, and the flow limiter is set so that the flapper of the flow indicator is 3/4 open when the purge valve is depressed for 30 seconds
4-9	2	2. The lower in-tank reservoir and connecting lines are filled with sea water when the purge valve is depressed for 30 seconds
4-10.	3	3. Continuous readings are presented
4-11.	4	4. Both sides of the bellows are filled with sea water when the vent valves are opened

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4-12. There are NO maintenance requirements for which of the following?
1. Flow indicator
2. Purge valve
3. Multifunction selector
4. Differential pressure gage

4-13. What are the correct valve positions when the hand pump and sump model gage are in operation?
1. Valves 1, 2, 3, 4, and 9 open, and valves 5, 6, 7, 8 and 10 closed
2. Valves 1, 2, 5, 6 and 9 open, and valves 3, 4, 7, 8, and 10 closed
3. Valves 1, 2, 3, and 4 open, and valves 5, 6, 7, 8, 9, and 10 closed
4. Valves 1, 2, 5, 6, 7, and 9 open and valves 3, 4, 8 and 10 closed

4-14. On the hand pump and sump model, the quantity reading is taken directly from the gage.

4-15. When is the valve between the common suction header and the outer tank sea water supply riser open?
1. When the tanks are being filled with sea water
2. When the tanks are being emptied of sea water
3. During normal operation
4. When either 1 or 2 above occurs

4-16. Arrange the following high-capacity AvGas system components for the correct flow of sea water through them.

A. Sea-water pumps
B. Diffuser
C. Outer tank sea-water supply riser
D. Sea chest supply riser
E. Common suction header
F. Outer tank
G. Common discharge header
H. Sea chest

1. D, H, E, A, G, B, C, F
2. E, A, H, D, B, G, C, F
3. E, D, H, A, G, B, C, F
4. H. D. E. A. G. C. B. F

4-17. The spectacle flange in the outer tank sea-water supply riser is rotated closed when which operation(s) is/are to take place?
1. Steaming the tanks
2. Flushing the supply line
3. Filling the tanks with sea water
4. Any of the above

4-18. What maintain(s) adequate back pressure in the tanks to force the fuel to the suction side of the AvGas pumps when maximum delivery of AvGas is being made?
1. The sea-water pumps
2. The size of the outer tank
3. The size of the drawoff tank
4. The height and size of the overflow loop

4-19. What function is served by the leak line?
1. It indicates any leak from the salt-water pumps
2. It indicates any leak (AvGas or sea water) from the tanks
3. It assures that the tanks will always be filled with liquid
4. It assures a sharp cleavage line between the AvGas and sea water

4-20. What prevents vapor lock in the AvGas pumps?
1. The location of the pumps
2. The self-priming capabilities of the pumps
3. The 1/2 to 1-psi pressure maintained in the tank by the sea-water system
4. All of the above

4-21. The salt-water pump is always started with the discharge valve closed.

4-22. In order for the fixed eductor to operate properly, you must maintain a minimum firemain pressure of
1. 70 psi
2. 80 psi
3. 90 psi
4. 100 psi

4-23. Which of the following is NOT a normal use of the portable eductor?
1. Draining sea water from the flushing lines
2. Removing drainage water from the cofferdam
3. Removing drainage water from the AvGas pumproom
4. Removing sea water from the stowage tanks that cannot be removed by the salt-water pumps

4-24. The motors for the aviation gasoline pumps are located in the same room as the motors for the sea-water pumps.

4-25. Refer to figure 5-19 in your textbook. Where are the N_2 lines connected into the AvGas system?
1. Common discharge header, drain line header, and filter discharge and bypass line
2. Filter discharge and filter bypass line, common suction header, and recirculating header
3. Common suction header, common discharge header, and drawoff tank riser
4. Common suction header, common discharge header, and drain line header

4-26. Which of the following actions prevents the AvGas boost pumps from overheating?
1. The shut-off valve in each pump recirculating line opens automatically when the temperature of the fuel being discharged from the pump reaches 100°F
2. The leak line allows 5 percent of the rated capacity to recirculate to provide pump cooling
3. The shut-off valve in each pump recirculating line is opened before the pump is started
4. Any of the above may be used to prevent overheating, depending upon the system installed

4-27. The valve in the bypass line from the common suction header to the common discharge header is opened during which of the following operations?
1. Venting
2. Receiving AvGas aboard
3. Draining back the system
4. All of the above

4-28. The riser pressure is maintained below the defueling pump pressure to drain the AvGas hose.

4-29. The totalizing meter, which accurately measures the fuel to the service station and the fuel defueled back into the distribution riser, is used to determine the quantity of fuel in the stowage tank.

4-30. What component determines the life of the parts of the aviation fuel meter?
1. Propeller blade
2. Straightening vane
3. Front ball bearing
4. Gears

4-31. If a leak occurs in the inner wall of the double-walled piping, the N_2 pressure gage in the pumproom will drop below 10 psi.

4-32. The relief valve located in the double-walled piping system is set to relieve at a pressure of
1. 10 psi
2. 15 psi
3. 20 psi
4. 25 psi

In items 4-33 through 4-35, select from column B the open valve that you close by each procedure listed in column A.

	A. Procedures	B. Valves
4-33.	Turn the valve handle 90° clockwise.	1. Rotary plug
4-34.	Turn the valve handwheel 90° counterclockwise.	2. Okadee swing gate
4-35.	Turn the valve handwheel clockwise until the sector arrow and the nameplate arrows are aligned.	3. Butterfly

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Learning Objective: Recognize the proper use, operation, adjustments, and characteristics of nitrogen, CO_2, and autogas systems.

In items 4-36 through 4-38, select from column B the area associated with each nitrogen use listed in column A.

	A. Uses	B. Areas
4-36.	To protect against fire or explosion	1. Double-walled piping
4-37.	To indicate piping leaks	2. Distribution piping
4-38.	To drain back or purge	3. Cofferdam

In items 4-39 through 4-42, select from column B the location of the components listed in column A.

	A. Components	B. Locations
4-39.	Charging valve for double-walled piping	1. Gasoline pump-room
4-40.	Reducing panel	2. Producer room
4-41.	Pressure gage for double-walled piping	3. Third deck access trunk
4-42.	Charging valve for distribution piping	

4-43. After the nitrogen pressure regulating valve has been adjusted and put in operation, it is opened by

1. pressure on the upper surface of the diaphragm
2. an increase in dome pressure
3. an increase in intake pressure
4. an increase in discharge pressure

4-44. In which sequence should you take the following steps to adjust the reducing valve?

A. Close the body needle valve
B. Close the valve body needle valve and dome needle valve
C. Slowly open the dome needle valve
D. Close the dome needle valve
E. Close the stop valve and open the inlet and low-pressure gage valves
F. Open the body needle valve 180 degrees

1. F, E, A, D, B, C
2. A, E, F, C, D, B
3. B, E, F, C, D, A
4. C, F, A, D, E, B

4-45. What is the correct or incorrect status of the following statements concerning the CO$_2$ System?

A. There are 8 CO$_2$ cylinders in each motor room that may be discharged from a pull box located inside the third-deck access trunk

B. There are 6 CO$_2$ cylinders for the aft filter rooms that may be discharged from a pull box located outside the access trunk on the second-deck level

C. There are 2 CO$_2$ cylinders for each forward filter room that may be discharged from the hangar deck

1. A and C only are correct
2. B and C only are incorrect
3. All the statements are correct
4. All the statements are incorrect

4-46. What will occur when the CO$_2$ pressure-actuated switches are energized?

1. The ventilation fan motors will be stopped
2. A warning bell and a red light will be actuated in damage control central or in a hangar bay, as appropriate
3. A warning bell inside the area and a visual warning at the space access will be actuated
4. All of the above will occur

4-47. As a safety measure, NO one may enter a compartment in which CO$_2$ has been released for at least 15 minutes after the ventilation has been restored and the gas-free officer has ensured it is safe.

4-48. How often must the fixed CO$_2$ installations be inspected to ensure all electrical circuits, pressure switches, and all visual and audible alarms are operating properly?

1. Daily
2. Weekly
3. Monthly
4. Annually

4-49. How does the autogas system differ from the AvGas system?

1. In the types of fuel pumps
2. In the construction of the cofferdams
3. In the number and location of the stowage tanks
4. In both 1 and 3 above

Learning Objective: Recognize the purposes of and procedures for flushing, steaming, and cleaning the AvGas stowage tanks and the safety precautions which should be observed.

4-50. Why are the Lamicoid charts provided for the AvGas system?

1. To provide a diagram of the entire system
2. To give detailed procedures on the various operations
3. To be used as a training aid when checking out a new pumproom operator
4. To accomplish all of the above

4-51. Which of the following inspections must be completed prior to conducting any operations concerning the AvGas system?

1. Inspect all valves requiring a locking device to ensure they are all locked in the closed position
2. Inspect all release mechanisms related to the CO$_2$ fire extinguishing system
3. Inspect all gage valves to ensure they are all closed
4. The inspections in both 1 and 3 above must be completed

4-52. Because sea water will damage AvGas pump shaft seal packings, sea water is NOT permitted to go beyond what component in the system when off-loading AvGas preparatory to flushing the tanks?

1. Drain line header
2. AvGas supply riser
3. Recirculating line header
4. AvGas pump suction header

4-53. After the flushing operation is completed, the drawoff tanks are emptied of sea water with air pressure and then inerted.

4-54. When the AvGas stowage tanks are drained, for how long are the sea-water pumps operated?
1. Until the tanks are empty
2. Until the pumps start to cavitate
3. Until the air pressure takes over
4. Until all of the above conditions are met

4-55. Most efficient removal of contaminated air from the cofferdams is accomplished by using air-driven exhausters and blowers.

4-56. Which of the following procedures must be followed before ventilated fuel tanks are entered?
1. The pumproom ventilation system must be placed in operation
2. The tanks must be checked with a combustible gas indicator and a flame safety lamp
3. A certificate signed by the gas-free officer must be posted at the tanks' entrances and a copy sent to the officer of the deck
4. All of the above must be followed

4-57. Steaming and cleaning AvGas stowage tanks accomplishes which of the following?
1. The lead residue is eliminated
2. The sludge on the sides is softened
3. The more volatile materials are boiled off
4. It accomplishes all of the above

4-58. Where is steam applied to the system when steaming out the AvGas stowage tanks?
1. To the steam supply valve in the pumproom and the steam-out connection in the sea chest
2. To the steam supply valve in the pumproom and steam-out connection in the outer tank manhole cover
3. To the steam-out connection in the sea chest and steam-out connection in the outer tank manhole cover
4. To the steam-out connection in the outer tank manhole cover and the steam-out connection in the filter inlet

4-59. When the AvGas stowage tanks are steamed, the steam flows from the outer tank to the inner tank, to the drawoff tank, up through the distribution piping, and out of the filling connection on the hangar deck.

4-60. What is the maximum temperature allowed when AvGas stowage tanks are steamed out?
1. 200° F
2. 212° F
3. 230° F
4. 250° F

4-61. Air pressure is used to help force the steam through AvGas stowage tanks and also to cool them when the steaming-out is complete.

4-62. From the operations listed below, select the correct sequence of procedures to be followed from the time AvGas stowage tanks are flushed until repairs can be commenced.
A. Washing and pumping
B. Ventilating
C. Cooling
D. Scraping and wiping
E. Steaming
1. E, C, B, D, E, B, A, B
2. E, C, B, A, E, B, D, B
3. E, B, C, A, E, B, D, B
4. E, B, C, D, E, B, A, B

4-63. When a person enters an AvGas stowage tank that is NOT thoroughly clean and dry, what must he take particular care to do?
1. Wear an air-line-hose-mask
2. Have a lifeline attached to him
3. Have a reliable man attend the lifeline from outside the tank
4. All of the above

4-64. When men are working in AvGas stowage tanks, the ventilation is checked by continually operating a flame safety lamp in the space and by making frequent tests with a hydrocarbon vapor indicator.

Learning Objective: Relative to the filling of stowage tanks with sea water, the receiving of AvGas aboard ship, and the fueling and defueling of aircraft, identify procedures followed and the functions of associated system components.

4-65. Which of the following statements is NOT a correct safety precaution that the man in charge of an AvGas tank cleaning party must insist that his men observe when working in a tank?

1. They must not carry matches or an automatic lighter
2. They must wear clothes and shoes that will not strike sparks
3. They must use tools with plastic handles to prevent striking a spark
4. They must use steam-tight, globe-type, portable lamps with all ferrous metal parts protected to prevent striking a spark

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In items 4-66 through 4-69, select from column B the component, used in filling the AvGas stowage tanks with sea water, that performs each function listed in column A.

	A. Functions		B. Components
4-66.	Vents the tank	1.	1/2-inch bypass leakoff connection
4-67.	Throttles the flow of sea water as filling nears completion	2.	Valve between the sea chest supply line and the sea-water pump suction header
4-68.	Stops the flow of sea water when filling is complete	3.	Hangar deck filling connections
4-69.	Keeps the tank filled with sea water and serves to relieve excessive tank pressure	4.	Tank top valve

4-70. When AvGas is received aboard ship, when does the tanker begin pumping at a normal rate?

1. When the gage in the inner tank indicates empty
2. When the tank top shutoff is opened
3. When sea water begins to come through the overflow loop
4. When AvGas is visible in the reflex gage on the AvGas pump suction header

4-71. How can receiving AvGas from a barge be expedited?

1. By using a "Y" to connect two 4-in. hoses to a 6-in. hose
2. By reducing the number of tanks to be filled by internal transferring
3. By venting and filling the AvGas distribution piping before refueling
4. By doing all of the above

In items 4-72 through 4-75, select the operation listed in column B that is associated with each statement listed in column A.

	A. Statements		B. Operations
4-72.	N_2 enters the AvGas pump suction header and the recirculating line header.	1.	Flooding
4-73.	N_2 enters the filter bypass and discharge line.	2.	Pressurizing
4-74.	All venting lines are secured.	3.	Draining
4-75.	It is accomplished prior to starting the AvGas pumps to prevent shock to the filter elements.	4.	Purging

Assignment 5

Aviation Lube Oil Systems; Fuels Division Ashore: Quality Assurance and Surveillance

Text: Pages 134 - 159

Learning Objective: Recognize capabilities of the aviation lube oil system, how the system functions, and procedures for operating it.

5-1. What operating conditions may be obtained by the arrangement of the piping in the pumproom?
1. Either or both pumps may take suction from or may discharge to the filling line
2. Either or both pumps may take suction from the ready service tank to assist in draining the system
3. In the event of damage, the return mains and risers may be utilized as supply mains and risers, by operation of the valves in the pumproom
4. Any of the above conditions may be obtained

5-2. When the lube oil stowage tanks are filled from drums, the flow of oil from each drum is controlled by the
1. top cap of the drum
2. large cap over the funnel
3. filling connection cap
4. filling pump pressure

5-3. When the stowage tanks are filled, during which of the following operations is the suction of the lube oil pumps used?
1. Pouring from drums
2. Siphoning from drums
3. Loading from a truck on the dock
4. All of the above

5-4. What is the maximum number of gallons of lube oil that should be put into a 1,000-gallon stowage tank?
1. 1,000 gal
2. 900 gal
3. 950 gal
4. 850 gal

5-5. Before being discharged to the ready service tank, lube oil in the stowage tanks should be preheated to an approximate temperature of
1. 84° F
2. 92° F
3. 100° F
4. 108° F

5-6. In what order should you take the following steps to provide lube oil to the ready service tank?
A. Open the rotary plug valves on each side of the back pressure valve
B. Open valves P and Q
C. Open valves E and F at the strainer inlet and outlet
D. Open valves A and B of the desired pump
E. Start the pump
F. Open valve G from the tank
1. F, D, C, A, E, B
2. B, C, D, E, A, F
3. F, B, A, C, D, E
4. B, E, F, A, C, D

5-7. What gage is used to observe the filling conditions when oil is being pumped from the stowage tank to the ready service tank?
1. Pressure return gage
2. Main deck riser gage
3. Gallery deck ready service gage
4. Ready service tank level gage

5-8. Refer to figure 6-1 in your text. Which valves should be left open when the lube oil system is secured?
1. N and P
2. M and Q
3. M and N
4. P and Q

5-9. Which sources of contamination should be checked each time lube oil is dispensed from them?
1. The stowage tanks
2. The ready service outlets
3. The ready service tanks
4. All of the above

Learning Objective: Relative to aviation lube oil system pumps, recognize types used and component functions.

Items 5-10 through 5-25 refer to the lube oil pump.

5-10. What type of pump is used in the aviation lube oil system?
1. Vertical, rotary, shaft-type, nonpositive displacement, dual-stage
2. Vertical, rotary, screw-type, positive displacement, single-stage
3. Vertical, centrifugal, shaft-type, nonpositive displacement, dual stage
4. Vertical, impeller driven, screw-type, positive displacement, single-stage

5-11. The idler rollers perform which of the following functions?
1. They drive the pump and provide power for the power rotor
2. They reduce oil flow at the discharge end of the rotor head
3. They are utilized for sealing purposes
4. They lubricate the pump by permitting leakage at the discharge and suction passages

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Learning Objective: Recognize correct starting and operating procedures for the lube pump, and identify maintenance practices and likely causes of operating troubles.

5-12. The rust preventive compound contained within a pump that has never been operated should be removed by
1. wiping with dry cotton waste
2. wiping with a mild solvent
3. washing with warm water and soap
4. normal operation of the pump

5-13. Air is removed from the pump suction line by filling the pump case and the suction line with oil. This process is called
1. packing
2. plugging
3. priming
4. discharging

5-14. What should you do if the pump does NOT discharge after several starts?
1. Test the suction pressure
2. Test the discharge pressure
3. Introduce air into the suction line
4. Run the pump several minutes without oil

5-15. A noticeable decrease in suction pressure near the pump indicates the possibility of
1. an obstructed suction line
2. worn bearing rings
3. improperly aligned helical grooves
4. loose gland nuts

5-16. Rapid wear of the pump housing and bearings can be caused by
1. failing to exercise proper maintenance procedures
2. running the pump too fast
3. running the pump without oil
4. running the pump under excessive oil pressure

5-17. Which of the following is indicated if there is a slight leakage around the shaft packing after the suction and discharge valves are opened and the motor is started?
1. Defective packing
2. Excessive discharge pressure
3. Inadequate suction pressure
4. Normal operation

5-18. How often should the suction and discharge pressure be checked when the pump is operating?
1. Constantly
2. Hourly
3. Every 10 minutes
4. Every 30 minutes

5-19. Which function is NOT performed by the relief valve that is mounted on the pump case?
1. It seals the metallic packing against air leakage during suction lift
2. It relieves excessive oil pressure above 15 psi
3. It relieves pressure on the internal balance piston on its upward thrust
4. It discharges oil to the suction side of the pump when pressure exceeds the valve setting

5-20. What prevents oil from leaking at the point where the shaft passes through the packing box?
1. A flexible metallic packing ring and a packing gland
2. A packing gland and four staggered, flexible metallic packing rings
3. Two aligned metallic packing rings and two flexible packing glands
4. Four staggered packing glands and a flexible packing ring

5-21. The packing glands are made in two parts so that the seal can remain intact even though part of the glands have to be removed in order to service the pump.

5-22. Case-end cover leakage can be caused by which of the following?
1. Defective gaskets
2. Foreign matter in the gaskets
3. Loose nuts and bolts
4. Any of the above

5-23. Detailed lubrication instructions for the pump driving unit are contained in the
1. NAVSHIPS Manual
2. Aviation Lube Oil Systems Instructions
3. instructions accompanying each unit
4. Instruction Book, Aviation Lube Oil Pump, NAVSHIP 347-2329

5-24. A noticeable decrease in discharge pressure over a period of time indicates that
1. contaminated oil may have been pumped
2. there is an obstruction in the discharge line
3. the bearing rings are worn and leaking
4. the helical grooves are not properly aligned

5-25. An excessive amount of air entrapped in the oil while the pump is operating may be indicated by
1. low discharge pressure
2. high discharge pressure
3. overloading
4. abnormal noises

Learning Objective: Relative to the organization of a fuels division ashore, recognize the functions of the different branches, personnel assigned, and their related responsibilities.

5-26. The fuels officer billet, which is the same as the V-4 division officer billet aboard a carrier, may be filled by whom?
1. A civilian
2. An ABFC
3. A supply corps officer
4. Any of the above

In items 5-27 through 5-29, select from column B the branch of the fuels division which performs each function listed in column A.

A. Functions		B. Branches
5-27.	Performs operator maintenance on fuel farm equipment	1. Mechanical operations
5-28.	Performs all accounting for the entire fuel farm	2. Inventory control
5-29.	Performs operator maintenance on delivery equipment.	3. Quality assurance
		4. Aircraft fuels delivery

5-30. To which branch of the fuels division ashore will an ABF3 most likely be assigned?
1. Aircraft fuels delivery
2. Mechanical operations
3. Inventory control
4. Quality assurance

5-31. The fuels chief of the aircraft fuels delivery branch is directly responsible for which functions?
1. Supervising all assigned field supervisors
2. Ensuring that all safety regulations concerning handling of liquid fuels are observed
3. Ensuring that discrepancies noted by the quality assurance branch are corrected
4. All of the above

5-32. Besides his administrative duties, the training petty officer is largely responsible for
1. the coordination of the training program throughout the division
2. teaching classes on all phases of fuel operations
3. dispatching mobile refuelers
4. maintaining issue documents for the fuels inspector

5-33. Refueler inspections and checks are a responsibility of the section leaders.

Learning Objective: Relative to refueling stations, identify construction features of the service tanks, operating characteristics and procedures associated with the stations, including installation, operation, and element replacement of related filter/separators.

5-34. Which of the following means are approved to segregate the different grades of fuel?
1. Blank flange
2. Spectacle plate
3. Double valve with open drain
4. Any of the above

In items 5-35 through 5-37 refer to figure 7-2.

Select from column B the product described by the markings listed in column A.

	A. Markings		B. Product
5-35.	One narrow band	1.	Lubricating oil
5-36.	Three narrow bands	2.	Jet fuels
5-37.	No bands	3.	Aviation gasoline
		4.	Diesel fuel

5-38. By what means are piping and containers used with petroleum products identified?
1. By the nomenclature printed white on a black background
2. By the number of bands utilized
3. By the NATO symbols
4. By any of the above means

5-39. Fuels NOT listed as being interchangeable may be interchanged using certain restrictions.

5-40. How are skid-mounted refuelers classified?
1. As fixed equipment
2. As movable equipment
3. As mobile equipment
4. As either 2 or 3 above

5-41. Relative to aircraft refueling stations, which of the following statements is correct?
1. Because skid-mounted refuelers are large and bulky, their presence adjacent to taxi strips is considered hazardous and is prohibited
2. Skid-mounted refuelers include all the associated metering, dispensing, and filtering equipment necessary, except as a source of auxiliary power for the aircraft being refueled
3. The skid-mounted refuelers and their associated equipment can be arranged to permit refueling of aircraft with their engines idling
4. Currently, the refueling stations which are built around skid-mounted refuelers require the aircraft to be moved to the station under auxiliary power

5-42. If the fuse sensing elements in the monitor at the refueling station cause the flow of fuel to be cut off, what does this indicate?
1. The monitor is functioning properly
2. The fuel is contaminated
3. The upstream filter is malfunctioning
4. All of the above

5-43. What method is used on a day-to-day basis to maintain the fuel consistently contamination-free?
1. Pressure readings are taken at the inlet and outlet sides of the filter elements and the pressure drops recorded
2. Pressure readings are taken at the exit from the ready service tanks and at the hose nozzle and the pressure drops recorded
3. The filter elements are changed, cleaned, and replaced
4. The fuses in the monitor are replaced

5-44. Although the skid-mounted refueling stations are reliable, they are considered inferior to mobile-type refueling equipment.

5-45. Filter/separators are designed to remove from aviation fuel a minimum of
1. 100% of all solids and water
2. 98% of all solids 5 microns or smaller, and 99.9% of free water
3. 99.9% of all water, and 98% of all solids 5 microns or larger
4. 90% of all suspended water and 95% of all solids

5-46. Installation of new filter/separator elements requires which of the following procedures be observed?
1. Taking frequent samples downstream of the filter/separator
2. Observing and recording pressure drops across the filter/separator
3. Flushing out the interior of the filter/separator case with clean fuel
4. All of the above

5-47. For daily operations, where should samples be drawn from a filter/separator?
1. Downstream from the filter/separator under full-flow conditions
2. Downstream from the filter/separator under static-flow conditions
3. Both upstream and downstream from the filter/separator under static-flow conditions
4. Both upstream and downstream from the filter/separator under full-flow conditions

5-48. As an iterim measure under combat conditions, filters are cleaned by reverse flushing.

5-49. Which of the following is NOT an element change requirement for a filter/separator qualified under Specification MIL-F-8901 with a monitor?
1. The element must be replaced at least every 2 years
2. If the monitor is independent of the filter/separator, the element must be replaced if the pressure drop across the monitor exceeds 20 psi
3. The element must be replaced if a pressure drop across the filter/separator reaches 15 psi
4. If the monitor is installed in the filter/separator, the element must be replaced if the pressure drop across the monitor reaches 26 psi

5-50. Immediate investigation is required if there is a sudden decrease in pressure drop.

Learning Objective: Recognize characteristics of mobile refuelers, operator responsibilities, and facts relative to fuel issue accounting.

5-51. Relative to the 5,000-gallon, chassis-mounted mobile refueler, which of the following is correct?
1. The system contains its own pump, filter/separator, fuel meter, monitor, discharge nozzles, and control system
2. The tank is divided into two horizontal compartments, and the fuel on top is used first to provide for the settling of contaminants
3. A disadvantage of this refueler is its top-loading aspect which requires personnel to be on top of the tank during refilling operations
4. This refueler is limited to jet aircraft in its application since it is capable of underwing or pressure refueling only

5-52. The monitor downstream from the filter/separator on the mobile refueler is similar to the monitor at the island-type refueling station in that both monitors are capable of monitoring the filter/separator, trapping and retaining foreign matter, and absorbing undissolved water.

5-53. What does the bottom loading feature on the 5,000-gallon mobile refueler provide for?
1. More positive control against mistakes in fuel selection
2. Greater fuel stability during loading
3. Less fuel contamination
4. All of the above

5-54. The driver of the refueler is responsible for all but which of the following?
1. Draining the sumps on the refueler
2. Connecting the fuel nozzle to the aircraft
3. Ascertaining that no source of ignition is present
4. Ensuring that the refueler is parked as far from the aircraft as the fueling hose will permit

5-55. Relative to fuel issue accounting, which statement is correct?
1. Regardless of the circumstances, civilian aircraft on contract to the Navy are the only civilian aircraft authorized to obtain fuel at naval air stations
2. The DD Form 1348 is not required for transient aircraft since the aircraft flight packet contains the proper transient aircraft refueling chit
3. Due to the possibility of fuel contamination, credit can never be allowed for fuel defueled from an aircraft
4. The DD Form 1348 is the basic military issue document for aviation fuels

Learning Objective: Recognize the possibility of greater fuel contamination ashore than afloat.

5-56. The possibility of fuel contamination is greater ashore than aboard ship because
1. there is no organization directly concerned with quality assurance ashore which is capable of functioning as efficiently as shipboard quality assurance organizations
2. the fuel handlers operate under less strict control
3. the dispersed locations of the various parts of the fuel stowage and transfer system provide more opportunities for the introduction of contamination
4. fuel farms ashore are generally undermanned

Learning Objective: Relative to fuel contamination, identify common contaminants and recognize allowable limits, propagation conditions, and resulting damage.

5-57. When using an AEL Free Water Detector, Mark 1, an experienced operator can determine the free water content in fuel up to
1. one or two parts per million
2. three or four parts per million
3. four parts per million
4. five parts per million

5-58. Which foreign particles resemble black powder when they are in fuel?
1. Microbiological growths
2. Brass shavings
3. Grains of black rust
4. Bits of rubber

5-59. Sticky or gelatinous white or grey paste in fuel indicates contaminants of
1. rubber
2. rust and rubber
3. aluminum or magnesium compounds
4. aluminum or magnesium compounds and water

In items 5-60 through 5-62, select from column B the foreign particles identified by the phrase in column A which describes how each appears in fuel.

	A. Descriptive Phrases	B. Foreign Particles
5-60.	Bright, gold-colored chips or dust	1. Rubber
		2. Magnesium compound
5-61.	A crystalline, granular, or glass-like form	
		3. Brass
5-62.	Fairly large black irregular bits	4. Sand

5-63. In order to prevent failure of the components of a fuel system as a result of sediment contamination, what is the maximum amount of sediment that can be delivered to an aircraft?
1. 1.0 milligrams per liter (1.0 mg/l)
2. 2.0 milligrams per liter (2.0 mg/l)
3. 3.0 milligrams per liter (3.0 mg/l)
4. 4.0 milligrams per liter (4.0 mg/l)

5-64. What will be the predicted reliabilty of an aircraft's fuel system if the sediment in the fuel measures between 5 and 10 mg/l?
1. Fair
2. Good
3. Poor
4. Excellent

5-65. The condition necessary for propagation of microbiological growth is the presence of
1. hydrocarbons in a fuel in which sediment is suspended in free water
2. hydrocarbons in a fuel kept at normal temperature
3. water in any form and hydrocarbons
4. free water and hydrocarbons

5-66. What form of microbiological growth usually contaminates fuel that has been stored in a warm climate for several months?
1. Green fungus
2. Brown fungus
3. Nitrogen-reducing fungus
4. Sulfate-reducing bacteria

5-67. If brown fungus breaks loose from the bottom of an aircraft fuel tank, which component(s) can become clogged and fail to operate properly?
1. Quantity gage probes
2. Flow dividers
3. Fuel control
4. Any of the above

Learning Objective: Identify precautionary measures in fuel handling and the criteria for visually determining the extent of contamination.

5-68. Which of the following steps must be taken to prevent contamination when fuel is transferred from one stowage tank to another?
1. The tanks must be checked for indications of contaminants
2. The brown hormodendron fungus must be removed
3. The water and sediment must be stripped
4. Both 1 and 3 above must be done

5-69. The major criterion for the detection of coarse contamination during visual inspection of fuel is that the fuel be
1. clean, dark, and contain visible sediment
2. clean, bright, and contain no free water
3. clean, bright, and contain free water
4. clean, dark, and contain some emulsion

5-70. What is the meaning of the term bright when it is used to refer to the appearance of fuel subjected to visual inspection?
1. The shiny appearance of clean, dry fuel
2. The absence of emulsion
3. The presence of a cloud or haze
4. The presence of brass particles

5-71. If another grade of fuel is mixed accidentally with JP-5, before this mixture can be stored aboard an aircraft carrier it must be tested by the laboratory to ensure that
1. the free water content is a minimum of seven parts per million
2. not more than 5.0 mg/l of sediment is present
3. the flashpoint is within allowable limits
4. there is no dissolved water in the fuel

5-72. Sounding tapes employing the principle that water will change the color of the tape's paste are used to determine the water level in a fuel tank and to indicate when free water is entrained in the fuel.

Assignment 6

Quality Assurance and Surveillance

Text: Pages 159 - 199

Learning Objective: Identify procedures and devices used in fuel testing, and the operating principles of solid and free water contamination detectors.

6-1. An ABF should be trained to sample petroleum products properly because improper sampling can result in wasted manhours and worthless information. Since directions for sampling can NOT be made clear for every case, how should he supplement any instructions received?
1. By experience
2. By skill
3. By judgment
4. By all of the above

6-2. Which statement correctly expresses the broad intent of the rules for fuel sampling?
1. Cleanliness of the sample container and fuel orifice is of paramount importance
2. Cleanliness is of paramount importance, and sampling should be done while the fuel is at rest
3. Cleanliness, representative sampling, and expeditious handling are of paramount importance
4. The sample container must be meticulously clean, and the sample must be taken after each fueling operation

6-3. Which of the following is NOT a requirement for the identification of a sample?
1. The location and name of the activity submitting the sample
2. The location of the point where the sample was taken
3. The flashpoint of commingled fuel
4. The sample classification

6-4. Under normal operating conditions, when is the flashpoint of JP-5 fuel tested in the laboratory?
1. When the sediment particles are 40 microns or larger in size
2. During routine sample testing
3. After the fuel has been transferred to another stowage tank
4. When the dissolved water is one-half of the allowable limit

6-5. Samples of jet fuel and gasoline used by the Navy and the Air Force may be shipped by railway express in amounts NOT exceeding 10 gallons, and in military and passenger-carrying aircraft in amounts NOT exceeding 1 gallon.

Items 6-6 through 6-9 pertain to the AEL MK III contaminated fuel detector.

6-6. This detector employs the principle that
1. trapped solid contaminants increase the amount of light passing through the filter
2. trapped solid contaminants decrease the amount of light passing through the filter
3. solid contaminants increase the weight of the top filter more than the dye increases the weight of the bottom filter
4. the ratio of solids trapped in the top filter to solids trapped in the bottom filter is indicative of the amount of solid contaminants present

6-7. The detector gives valid information on normal pattern contamination by
1. solids only
2. solids and water
3. biological growth only
4. solids and biological growth

6-8. During the filtration cycle, the fuel in the sample bottle should be
1. gently agitated
2. inspected visually
3. drained by gravity only
4. pressurized by applying pressure to the polyethylene sample bottle

6-9. When must this detector be calibrated?
1. Monthly
2. Quarterly
3. Whenever a part is replaced
4. Both 2 and 3 above

6-10. When you perform a free-water-in-fuel test, in which order should you perform the following steps to obtain valid results?
A. Shake the fuel sample for approximately 30 seconds, then turn the vacuum pump on
B. Compare the brightness of the test pad with the set of standards to determine the amount of free water
C. Make sure the detector reservoir is empty and the drain valve is closed
D. Fill the sample bottle with 500 cc of fuel
E. Place the receiver bottle over the sample bottle and insert the filter base into the detector

1. E, B, D, C, A
2. D, C, A, E, B
3. A, E, C, B, D
4. C, A, E, D, B

6-11. If the free-water-in-fuel is more than 20 parts per million (ppm), what additional test must you perform?
1. Test a second standard sample and double the answer
2. Test another standard sample in the same manner to ensure accuracy
3. Test a second sample one-half the amount of the standard sample and double the answer
4. Test another standard sample using one-half the answer

Learning Objective: Recognize the purpose, configuration, and operational features of the filter element test stand and the coalescer quality indications it provides.

● Items 6-12 through 6-22 refer to the filter element test stand.

6-12. Why is a filter element test stand necessary?
1. To determine the type of coalescer element before placing it in a fuel system
2. To determine the amount of water that the coalescer element will pass
3. To provide a means of testing coalescer elements in an actual flow situation using a mixture of fuel and water
4. To provide a collection of sediment particles within the coalescer element for a laboratory sample

6-13. A water receiving sump is provided for in the test tank by
1. means of a removable container in the left corner of the tank
2. the slanted right corner which extends the width of the tank
3. a recessed portion of the tank bottom along the entire length of the tank
4. a vertical pipe connected to the bottom of the tank

6-14. Which component provides an efficient and rapid method of testing the elements?
1. Swing joint
2. Holding assembly
3. Strainer assembly
4. Circular handle

6-15. Which function can NOT be accomplished through the use of the swing joint?
1. Lowering the holding assembly horizontally into the tank
2. Installing and removing the filter element
3. Raising the holding assembly vertically out of the tank
4. Rotating the filter element during test

6-16. The proper amount of water in the sump is indicated on the sight glass gage when the level is
1. exactly on the top red mark
2. exactly on the bottom red mark
3. between the two red marks
4. at the top of the gage

6-17. Which type of pump is used in the testing of a coalescer element?
1. Gear-driven
2. Vane
3. Centrifugal
4. Piston

6-18. When the liquid being discharged into the coalescer element is observed on the indicator gage to be more than 10 gallons per minute (gpm), what component must you manually adjust?

1. Drain valve
2. Pressure reducing valve
3. Flow control valve
4. Check valve

6-19. If the coalescer element installed on the holding assembly still rotates after the wingnut is tightened, what step must be taken to obtain the proper seal?

1. An additional end gasket must be installed
2. The element must be replaced
3. The end gasket must be removed
4. The holding assembly must be replaced

6-20. After rotating a coalescer element for two minutes, a satisfactory element will be identified by clear fuel and coalesced water droplets on the outer surface. A defective element will be indicated by a

1. white powder color at the point of leakage
2. bright gold color at the point of leakage
3. haze color similar to smoke at the point of leakage
4. coffee color at the point of leakage

6-21. Before a permanent type of Teflon filter/separator element can be installed, the element must be checked by

1. performing both a visual inspection and a leakage inspection
2. performing either a visual inspection or a leakage inspection
3. performing a visual inspection and a swirl test
4. performing a leakage inspection and a swirl test

6-22. Why should the centrifugal pump be operated for at least two minutes each week and be required to pump a full stream of fuel/water prior to being shut down?

1. To ensure that the pump is always ready for operation
2. To lubricate the bearings
3. To prevent rust buildup on the impeller and seal
4. To do all of the above

Learning Objective: Identify components, operational features, and principles of main fuel filters.

Items 6-23 through 6-31 refer to the main fuel filter.

6-23. What are the three chambers of the filter?

1. Sump, separator, and outlet
2. Sump, separator, and inlet
3. Inlet, sump, and outlet
4. Inlet, fallout, and outlet

6-24. What components are inserted in the threaded holes that are symmetrically arranged over the surface of the tube sheets?

1. Coalescer elements
2. Filter element mounting assemblies
3. Separator elements
4. Recirculator assemblies

6-25. When the threaded plug is tightened into the standpipe, leakage is prevented at the ends of the filter elements by the

1. smooth surface of the end caps forming a tight seal with rubber gaskets on the elements
2. fiber washers on the elements forming a tight seal against the knife edges on the end caps
3. end caps of the elements being assembled with fiber washers to form a tight seal
4. knife edges on the end caps projecting into the synthetic rubber gaskets on the elements

6-26. What type of material is used for filtering the fuel flowing through a coalescer element?

1. Perforated copper
2. Aluminum
3. Perforated paper
4. Fiber glass

6-27. The two-stage filtering process used in the main fuel filter to remove contaminants from fuel is efficient enough to remove

1. 50 percent of all solids five microns or above and 50 percent of all entrained water
2. 60 percent of all solids five microns or above and 80 percent of all entrained water
3. 85 percent of all solids five microns or above and 90 percent of all entrained water
4. 98 percent of all solids five microns or above and 99.9 percent of all entrained water

6-28. When the fuel from the coalescer element flows toward the separator elements, the coalesced water falls out of the fuel by gravity. In which chamber does this separation take place?

1. Outlet
2. Inlet
3. Fallout
4. Separator

6-29. The fuel leaving the inlet chamber and passing through the coalescer elements from inside to outside results in which of the following?

1. Solid contaminants passing out
2. Entrained water remaining in the fuel
3. Solid contaminants being removed and the entrained water in the fuel forming large droplets
4. Solid contaminants not being removed but the entrained water in the fuel forming large droplets

6-30. As fuel flows through the separator elements from outside to inside, the final stage of filtering is accomplished by

1. repelling coalesced water for suspension in fuel
2. passing both the coalesced water and micron particles in accordance with established standards
3. repelling all micron particles to the sump bottom
4. removing micron particles and repelling all traces of coalesced water

6-31. What visible means have been provided to determine the pressure drop across the filter elements?

1. Air gages
2. Pressure gages
3. Bull's-eye sight gages
4. Flow indicator gages

Learning Objective: Recognize the principle of operation of the horizontal and vertical main fuel filter hydraulic control systems, and identify maintenance checks and troubleshooting procedures.

Items 6-32 through 6-47 refer to the filter hydraulic control system.

6-32. When water reaches a predetermined level in a fuel filter and can NOT be drained at a fast enough rate to maintain this level, the hydraulic control system will prevent a further increase by

1. increasing the fuel flow
2. stopping the fuel flow
3. reducing the fuel flow
4. regulating the water flow

6-33. What provides a cushioning effect when the automatic shutoff valve is opened by the filter discharge pressure acting under the valve seat?

1. A tension spring in the lower valve assembly
2. A tension spring in the upper valve assembly
3. Fuel pressure on the bottom of the diaphragm
4. Fuel pressure on the top of the diaphragm

6-34. If fuel pressure is applied to the top of the double-acting diaphragm of the pilot valve, what sequence of actions will occur?

1. The valve opens, the actuating line opens, and the top of the diaphragm is vented to the atmosphere
2. The valve closes, the actuating line opens, and the bottom of the diaphragm is vented to the atmosphere
3. The valve closes, the actuating line closes, and the bottom of the diaphragm is vented to the atmosphere
4. The valve opens, the actuating line closes, and the top of the diaphragm is vented to the atmosphere

6-35. When the eductor causes a decrease in fuel pressure on top of the diaphragm of the shutoff valve, how will the shutoff valve be affected?

1. The filter discharge pressure will open the valve
2. The filter discharge pressure will close the valve
3. The tension spring will close the valve
4. The increase in filter discharge pressure applied to the top of the diaphragm will open the valve

6-36. Water will be discharged from the filter sump when the
1. water pressure is applied to the top of the diaphragm in the automatic water drain valve
2. water pressure is applied to the bottom of the diaphragm in the automatic water drain valve
3. fuel pressure is applied to the bottom of the diaphragm in the automatic water drain valve
4. fuel pressure is applied to the top of the diaphragm in the automatic water drain valve

6-37. What are the positions of the rotary control valve that is located on the side of the filter sump and attached to the ball float in the sump?
1. Down and up only
2. Down and horizontal only
3. Horizontal and up only
4. Down, horizontal, and up

6-38. Directing filter discharge pressure through its ports to the diaphragms of the pilot and automatic water drain valves is controlled by the position of the
1. pilot valve
2. automatic shutoff valve
3. rotary control valve
4. automatic water drain valve

6-39. If there is little water passing through the fuel filter and the ball float in the sump is in the down position, where will the rotary valve direct the filter discharge pressure?
1. To the top of the diaphragm of the water drain valve and to the bottom of the diaphragm of the pilot valve
2. To the bottom of the diaphragm of the water drain valve and to the bottom of the automatic water drain valve
3. To the top of the diaphragm of the water drain valve and to the top of the diaphragm of the automatic shutoff valve
4. To the bottom of the water drain valve diaphragm and to the top of the pilot valve diaphragm

6-40. When all valves of the filter hydraulic system are open and coalesced water is draining from the sump, what is the position of the ball float?
1. Down
2. Vertical
3. Horizontal
4. Up

6-41. Under which of the following conditions will the pilot and automatic shutoff valves be closed?
1. The eductor bypasses fuel applied to the top of the diaphragm of the shutoff valve
2. The ball float is in the midposition which repositions the rotary control valve
3. The rotary control valve directs fuel pressure to the bottom of the diaphragm of the automatic water drain valve
4. The automatic water drain valve cannot drain water fast enough to maintain the proper level

6-42. Which valve must you use to regulate the fuel pressure in order to maintain at lease 25 psi less than the available water pressure during the monthly test of the filter controls?
1. Pressure-regulating valve
2. Globe valve
3. Pilot valve
4. Automatic shutoff valve

6-43. If the drain valve has been manually closed, what action should you take when the automatic shutoff valve fails to close within 3 minutes?
1. Increase the water flow rate
2. Decrease the water flow rate
3. Increase the fuel flow rate at the inlet chamber
4. Secure the system and determine the cause

6-44. Which of the following should be checked when troubleshooting the hydraulic control system?
1. All manual valves for alignment
2. The copper tubing for internal obstructions
3. The strainers in the water drain line and the rotary control supply line
4. All of the above

6-45. After you remove the rotary control valve from the filter and place it in a vise, you apply low pressure air through the supply port. If the valve fails to operate properly, what action must you take?
1. Repair the rotary valve
2. Return the rotary valve to the factory
3. Increase pressure through the supply port
4. Reinstall the rotary valve

6-46. Under which condition is replacement of coalescer elements necessary?

1. The JP-5 output dropped below 200 gpm for a period of 5 minutes
2. The JP-5 output has been 300 gpm for a period of 15 minutes
3. The amount of JP-5 pumped has exceeded 300,000 gallons
4. The pressure differential has reached the maximum allowable pressure drop

6-47. Which of the following statements is correct concerning replacement of the coalescer elements?

1. Coalescer elements must be of the same manufacture as the separator elements
2. They must be from the same manufacture
3. They must be replaced annually
4. Both 2 and 3 above

Items 6-48 through 6-50 refer to the vertical filters.

6-48. In addition to physical shape and direction of flow, this filter and the horizontal filter differ in their

1. pressure gages and automatic shutoff valves
2. hydraulic control systems and pressure gage arrangements
3. hydraulic control systems and automatic shutoff valves
4. automatic water drain valves and automatic shutoff valves

6-49. Vertical filters eliminate the need for the ports in the rotary control valve. These ports control what valves in a horizontal filter?

1. Pilot and shutoff
2. Water drain and pilot
3. Shutoff and water drain
4. Water drain and clearwell

6-50. Vertical filters use two automatic water drain valves connected to a tee fitting. The simultaneous opening and closing of these valves is accomplished by the

1. pilot valve
2. fuel discharge valve
3. fuel shutoff valve
4. rotary control valve

6-51. The differential pressure gage used on the vertical filter is designed to indicate the difference in pressure between which of the following chambers?

1. Inlet and outlet chambers
2. Outlet and fallout chambers
3. Fallout and inlet chambers
4. Both 2 and 3 above

Learning Objective: Recognize the functions of the fuel-water separator and the centrifugal purifier first-stage filters, including construction features, operating procedures and principles, and maintenance techniques.

Items 6-52 and 6-53 refer to the first-stage filter.

6-52. When JP-5 is received from a hangar deck filling connection, contamination is kept to a minimum because the fuel is settled in stowage tanks and then pumped through a filter into the service tanks.

6-53. How are the coalescer and separator elements mounted in this filter?

1. The coalescer elements are mounted horizontally, and the separator elements are mounted vertically
2. The coalescer elements are mounted vertically, and the separator elements are mounted horizontally
3. Both the coalescer and separator elements are mounted horizontally
4. Both the coalescer and separator elements are mounted vertically

Items 6-54 through 6-74 refer to the centrifugal purifier.

6-54. How does the centrifugal force in the purifier operate?

1. It completely overcomes the force of gravity, allowing the impurities to separate from the JP-5
2. It impels the pure JP-5 upward and the impurities downward
3. It impels objects away from the center of rotation
4. It impels objects towards the center of rotation

6-55. After operation, at what position in the bowl will the solid contaminants be located?

1. In the heavy phase outlet
2. On the underside of the discs
3. At the outer edge of the discs
4. On the bowl wall

6-56. To obtain the maximum filtration of heavy elements from the JP-5, where should the holes in the discs be located?
1. Near the inner edge
2. Near the outer edge
3. On the upper edge of the intermediate discs
4. On the underside of the intermediate discs

6-57. The amount of still-mixed feed material in the bowl is controlled by the position of the
1. strainer
2. discharge ring
3. paring disc
4. regulating tube

6-58. Why is the centrifugal purifier so highly efficient?
1. Because separated liquids are kept apart from stored solids
2. Because filtering is as efficient at the end of a run as at the beginning of a run
3. Because contaminants and filtered JP-5 are continually forced away from each other
4. Because of all of the above

6-59. When the centrifugal purifier bowl has to be cleaned, which components function to allow rotation of the cover assembly?
1. The cover hinge, inlet assembly, and outlet assembly
2. The feed tube assembly and cover hinge
3. The feed tube assembly and ratchet hook
4. The cover hinge and ratchet hook

6-60. During fuel purification, the impure JP-5 is directed into the bowl and the purified JP-5 is directed out of the bowl by the
1. seal water inlet valve
2. inlet and outlet tube
3. feed tube assembly
4. regulating tube

6-61. When the bowl is revolving, the water is separated from the fuel and forced upward because it is heavier than the fuel. The water leaves the purifier by passing through the
1. feed tube assembly to the outlet tube on the cover assembly
2. outlet tube on the cover assembly to the water-discharge outlet
3. water-discharge chamber in the cover assembly to the water-discharge outlet
4. water-discharge chamber to the outlet tube on the cover assembly

6-62. When the cover assembly is closed, an O-ring seal will provide a liquid-tight seal between the cover and bowl casing if you tighten the
1. spring-loaded handle
2. three handwheel cover clamps
3. spring-loaded ratchet hook
4. ratchet hook catch

6-63. Before you start the purifier, you must ensure that the
1. spring-loaded ratchet hook is engaged on the bowl shell casing
2. lock screws are tightened in the bowl shell casing
3. spring-loaded handle is engaged to the paring disc
4. lock screw plugs are installed in the bowl shell casing

6-64. During starting and stopping, the purifier passes through a critical vibration range. What provisions are made to allow for safe passage of liquids through the water and bowl casing drain lines?
1. A locked-open globe valve is installed in the water drain line, and flexible piping is installed in the bowl casing drain line
2. A locked-open globe valve is installed in the water drain line, and a rubber hose is installed in the bowl casing drain line
3. Flexible piping is installed in the water drain line, and rubber hose is installed in the bowl casing drain line
4. Flexible piping is installed in the bowl casing drain line, and a rubber hose is installed in the bowl casing drain line

6-65. If there is a tendency for the spindle assembly to thrust upward when rotating at a speed of 4,100 rpm, what will absorb this thrust?
1. The horizontal springs only
2. The vertical spring only
3. The ball bearings
4. The horizontal and vertical springs

6-66. The purifier end of the centrifugal clutch rotates when the drive motor rotates and the friction weights
1. do not produce friction on the inner surface of the sleeve/housing of the purifier end
2. do not produce friction on the outer surface of the sleeve/housing of the purifier end
3. produce friction on the inner surface of the sleeve/housing of the purifier end
4. produce friction on the outer surface of the sleeve/housing of the purifier end

6-67. If the bowl is turning at full speed, what should be the rpm of the speed counter?
1. Between 100 and 130 rpm
2. Between 146 and 150 rpm
3. 1,770 rpm
4. 4,100 rpm

6-68. When the worm wheel gear that is partially submerged in oil rotates, which components will be lubricated?
1. Two of three sets of bearings on the spindle assembly
2. All bearings on the clutch drive shaft
3. All bearings in the clutch compartment
4. Bearings and gears in the lubrication compartment

6-69. When the centrifugal purifier operates to separate the contaminants, a fresh water seal is used to prevent loss of
1. emulsions
2. water
3. JP-5
4. solids

6-70. Separation between the bowl shell and the tubular shaft's base is necessary for liquid passage and circular motion of the feed inlet liquid. This separation is provided by
1. six outer spacers
2. eight outer spacers
3. twelve inner spacers
4. fourteen outer spacers

6-71. How are the intermediate discs aligned vertically in the bowl shell?
1. The notch on the inward lip at the top of each disc interlocks with the key on the tubular shaft
2. The notch on the outer lip at the bottom of each disc interlocks on the tubular shaft
3. The notch on the top of each disc spacer is keyed on the tubular shaft
4. The notch on the bottom of each disc spacer is keyed on the tubular shaft

6-72. Which disc provides a rotating casing for the centripetal pump?
1. Top disc
2. Coupling disc
3. Intermediate disc
4. Paring disc

6-73. You can firmly seat each disc in the stack on its adjacent disc, before you operate the purifier, by tightening the
1. spindle nut
2. coupling nut
3. coupling ring
4. discharge ring

6-74. In order to ensure proper tension on the disc stack, the coupling ring should be tightened on the bowl top until the aligning marks are lined up.

Assignment 7

Quality Assurance and Surveillance; Maintenance and Repair

Text: Pages 200 - 241

Learning Objective: Identify centrifugal purifier operating and maintenance procedures.

7-1. Prior to starting the purifier, there are certain steps that must be taken. In what order should you perform the following preliminary steps?
   A. Rotate the bowl by hand to check for freedom of movement
   B. Check the oil level in the sump
   C. Ensure the handbrake is in its OFF position
   D. Insert the bowl shell lock screw plugs
   E. Connect the hose to the seal water inlet plug
   F. Check for a cracked clutch lining
   1. F, C, A, E, D, B
   2. C, B, F, D, A, E
   3. C, D, A, B, F, E
   4. A, E, C, F, B, D

7-2. After the bowl shell of the purifier attains a speed of 4,100 rpm and the transfer pump is started, which valve should be opened simultaneously with the purifier inlet globe valve to maintain a back pressure of 30 psi?
   1. The purifier seal water inlet plug valve
   2. The transfer pump discharge valve
   3. The purifier discharge globe valve
   4. The transfer pump inlet valve

7-3. During purifier operation a log must be maintained on which of the following?
   1. The starting and stopping time of the purifier and transfer pump
   2. The inlet and discharge gage readings of the purifier and transfer pump
   3. The gross gallons of fuel removed from the stowage tank and the net gallons transferred into the service tank
   4. All of the above

7-4. Since the discharge ring determines the line of separation between JP-5 and water, what method should be followed when selecting the correct discharge ring after the specific gravity has been determined?
   1. The ring size should be used as indicated opposite the horizontal line on the chart
   2. The next larger ring size should be used instead of the size opposite the horizontal line on the chart
   3. The next smaller size ring should be used instead of the size opposite the horizontal line on the chart
   4. The ring two sizes smaller should be used instead of the size opposite the horizontal line on the chart

7-5. Which condition indicates that the water seal in the purifier has been lost?
   1. A small discharge of JP-5 with the water from the water outlet
   2. An excessive discharge of JP-5 from the water outlet
   3. Water being discharged with the JP-5 from the fuel outlet
   4. No loss of JP-5 from the water outlet

7-6. When should the purifier bowl be cleaned?
   1. When the wet bowl cake approaches 30 pounds
   2. When the wet bowl cake approaches 1 1/2 inches at its thickest point
   3. When the purifier is to be inactive for 12 hours or more
   4. When any of the above occurs

7-7. During disassembly of the purifier, which component must you take off immediately prior to removal of the bowl top?
   1. The coupling nut
   2. The bowl shell
   3. The coupling ring
   4. The tubular shaft

7-8. After the O-ring seals have been cleaned and inspected, what type of coating is applied to them before installation?
1. Gear oil
2. JP-5
3. Cleaning fluid
4. Machine oil

7-9. When clutch weight No. 1 is cracked, which corrective action should you perform?
1. Replace all friction weight linings
2. Replace clutch weights No. 1 and No. 3
3. Replace the clutch friction weights with a fan-cooled electric motor
4. Replace clutch weights No. 2 and No. 4

Learning Objective: Identify responsibilities of personnel in the aviation fuels system organization.

In items 7-10 through 7-13, concerning aviation fuels system maintenance, select from column B the person who performs each task listed in column A.

	A. Tasks		B. Personnel
7-10.	Supervises maintenance of the system during flight quarters	1.	Air officer
7-11.	Has charge of the aviation fuels repair team during general quarters	2.	Aviation fuels officer
7-12.	Organizes the aviation fuels repair team in accordance with the ship's battle bill	3.	Repair team petty officer
7-13.	Has responsibility for the coordination of all damage control matters during general quarters	4.	Damage control assistant

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Learning Objective: Identify factors relevant to the upkeep, use, testing, and maintenance of fuel systems, and to the performance of emergency maintenance repairs.

In items 7-14 through 7-16, select from column B the function of each item of portable equipment listed in column A.

	A. Equipments		B. Functions
7-14.	Flame safety lamp	1.	To measure the percent of oxygen reduction in an enclosed space charged with an inert gas
7-15.	Portable inertness analyzer	2.	To detect the presence of explosive or flammable mixtures of hydrocarbon vapors and air in an enclosed space
7-16.	Combustible gas indicator	3.	To protect personnel entering an enclosed space which contains toxic gas
		4.	To determine if there is sufficient oxygen in an enclosed space to support life

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7-17. When the toggle switch on the combustible gas indicator is in the CHECK position, the pointer should rest on a
1. red arrow on the right side of the dial
2. white arrow in the center of the dial
3. green arrow on the left side of the dial
4. green arrow in the center of the dial

7-18. What is indicated when the pointer on the combustible gas indicator can NOT be adjusted to zero with the explosive meter on?
1. The inlet and outlet filters are damaged
2. The detector's filament is burned out
3. The gas free vent is clogged
4. The atmospheric inlet valve is sticking

7-19. What advantage does the air-line mask have over the oxygen breathing apparatus?
1. Its regulator is equipped with two pressure gages, thereby affording greater safety
2. It enables the wearer to remain in the area for a longer period of time
3. It facilitates entering spaces which have extremely small access openings
4. Both 1 and 2 above

7-20. What is the preferred place for attaching a Navy standard lifeline to your body?
1. Under the arms
2. Around the waist
3. Through the backloop of the shoulder harness
4. Any of the above, depending on the circumstances

7-21. What controls the speed of the Boston pneumatic air motor when used to drive the internal gear-type pump?
1. A weight-type centrifugal governor
2. A 1/2-inch cock mounted on the unit
3. An automatic throttle control mounted on the unit
4. Both 1 and 2 above

7-22. What is included in the maintenance of the air motor?
1. Lubrication
2. Cleaning of disassembled parts
3. Repairing, replacing, and adjusting parts
4. All of the above

7-23. To carry out his assignment successfully, the aviation fuels team ABF must not only be familiar with the ventilation system below decks, but also know the location and function of all valves in the piping of the aviation fuels system.

7-24. Before entering a space near a ruptured fuel line that is charged with an inert gas, you should make a test with a combustible gas indicator. If no flammable gas is present, you should then test it with a flame safety lamp to determine if there is enough oxygen present to support life.

7-25. What can the emergency damage control metallic pipe repair kit be used for?
1. Stopping leaks from jagged protrusions
2. Repairing damaged straight pipe and elbows
3. Joining completely severed pipe ends
4. Any of the above

7-26. A small leak in the low-pressure sea-water piping may be repaired either by applying red lead putty wrapped with canvas and served with electric friction tape or by inserting a soft pine plug.

Learning Objective: Recognize causes of damage to joints and valves, and maintenance practices and safety factors associated with damage repair.

7-27. Leaks in piping joints may be caused by excessive strain from which of the following?
1. Normal vibration
2. Misalignment
3. Failure to allow for expansion
4. Either 2 or 3 above

7-28. If a thorough inspection of a leaking threaded joint reveals that the threads are in good condition, which of the following actions should you take?
1. Install a new section
2. Retighten the joint
3. Clean the parts and reassemble the joint using a suitable antifriction sealing compound
4. Any of the above

7-29. What can you do to stop a leak at a flanged joint if setting up on the flange bolts does NOT stop it?
1. Replace the gasket
2. Replace the flange
3. Reface the flange
4. Any or all of the above

7-30. What is the correct procedure for assembling a high-pressure flanged joint when the flanges are separated by 3/32 of an inch?
1. Use a suitable spacer and a thin gasket on each end
2. Use a 3/32-inch gasket coated with graphite on one side
3. Use two 1/16-inch gaskets coated with graphite on one side
4. Use a 3/32-inch gasket coated with graphite on both sides

7-31. Which of the following is NOT a safety precaution to be observed when breaking a flanged joint?
1. Be sure that pressure has been removed from the line
2. Close, lock, and tag the necessary valves
3. Remove the flange nuts in a predetermined sequence
4. Leave two diametrically opposite securing nuts in place while loosening the others

7-32. The flange safety shield is a leakage interceptor that confines within the immediate area of the bilge the spraying JP-5 from a blown flange gasket.

In items 7-33 through 7-36, select from column B the possible cause of each valve trouble listed in column A.

	A. Troubles	B. Causes
7-33.	Scored valve disc	1. Valve jammed shut when cold
7-34.	Sticking valve stem	2. Bent or scored valve stem
7-35.	Persistently leaking stuffing box	3. Excessive pressure used to move sticking valve
7-36.	Distorted valve stem threads	4. Erosion

Learning Objective: Recognize factors related to the construction, operation, and maintenance of centrifugal and rotary pumps used for pumping fuel and sea water, and for creating a vacuum suction.

7-37. A double suction service pump is one in which fuel is fed from both sides of the impeller simultaneously.

Items 7-38 through 7-47 refer to the Allis-Chalmers JP-5 service pump.

7-38. What changes the flow velocity to pressure in the pump?
1. The double suction action of the pump
2. The size of the pump discharge nozzle in relation to the size of the inlet
3. The design of the pump case
4. The rotation speed of the impeller

7-39. The impeller is centered and secured in the pump casing by the
1. shaft nuts and wearing rings
2. shaft sleeves and shaft nuts
3. bearing caps and shaft sleeves
4. wearing rings and bearing caps

7-40. What is the recommended procedure to prevent shaft nuts from backing off when the pump is in operation?
1. A locking nut should be installed
2. The shaft nut should be drilled and a locking wire installed
3. Right- and left-hand thread shaft nuts should be installed
4. The shaft nut should be drilled and tapped and a headless set screw installed

In items 7-41 through 7-45, concerning John Crane mechanical seals, select from column B the pump component associated with each statement in column A.

	A. Statements	B. Components
7-41.	Its mating surface is lapped to meet the lapped surface of the metal ring	1. Stationary floating seat
7-42.	It is housed in the stuffing box gland plate	2. Low-friction sealing washer
7-43.	It assures contact of the carbon seal and metal ring	3. Bellows assembly
7-44.	It compensates for the wear of the carbon seal	4. Spring
7-45.	It drives the mechanical seal	

7-46. You should use a gage provided by the manufacturer to determine the proper distance between the face of the gland nut plate and the shoulder on the sleeve of the pump.

7-47. The rotating assembly must NOT be installed in the lower casting if the stationary wearing rings, stuffing box throat bushings, and bearing adaptors are NOT aligned.

Items 7-48 through 7-51 refer to the Nash vacuum priming pump.

7-48. What is the correct flow of sealing water for the primary pumps?
1. Priming pumps → priming pumps suction line → "Y" strainer → seal suction line and orifice → tank bottom
2. Tank bottom → "Y" strainer → vacuum relief valve → seal suction line orifice → priming pumps
3. Tank bottom → seal suction line → "Y" strainer → seal suction line orifice → priming pumps suction line → priming pumps
4. Priming pumps → priming pumps suction line → vacuum relief valve → 1/16-inch orifice → "Y" strainer → seal suction line → tank top

7-49. What creates the vacuum in the pump?
1. The high-speed rotation of the service pump
2. The liquid following the elliptical shape of the lobe when the pump is in operation
3. The counterrotation of the liquid with respect to the rotation of the pump
4. The series of pockets constructed in the lobe impeding the liquid flow

7-50. The priming pumps should NEVER be turned through WITHOUT seal water in the casing, for serious damage will result.

7-51. What function is performed by the priming valve?
1. It admits water to prime the vacuum pumps
2. It admits fuel to prime the centrifugal fuel pumps
3. It removes air from the priming pumps
4. It removes air from the centrifugal fuel pumps

7-52. After the priming valve interior has been cleaned and inspected, the priming valve body must be drained for the float to center itself properly.

Items 7-53 through 7-55 concern aviation gasoline booster pumps.

7-53. What is the maximum allowable wear on the wearing rings?
1. 0.007-in. radial clearance
2. 0.014-in. radial clearance
3. 1/32-in. radial clearance
4. 1/16-in. radial clearance

7-54. What mechanical device keeps the line and thrust bearing sets oiled?
1. A flinger ring on the special bearing nut
2. An adjustable oil control valve
3. A gear-type oil pump
4. The constant-level oiler

7-55. The pumps are kept cool by
1. sea water
2. a cooling fan
3. the constant-level oilers
4. the aviation gasoline flowing through the case

7-56. The wearing rings and impeller require careful handling to prevent distortion during disassembly and assembly

Items 7-57 through 7-64 refer to the Weil KU-5 sea-water pump.

7-57. Where are the wearing rings located?
1. Two on the impeller and two in the pump casing
2. Two on the impeller, one in the pump casing, and one in the suction plate
3. Two on the impeller, two in the pump casing, and one in the suction plate
4. Two on each side of the impeller, one in the pump casing, and one in the suction plate

7-58. The inlet pressure is equalized around the impeller by means of
1. the size of the volute
2. the shape of the volute
3. the speed of the impeller
4. holes drilled through the impeller near the base

7-59. The water in the stuffing box serves which of the following functions?
1. Cooling
2. Sealing
3. Lubricating
4. All of the above

7-60. The bulkhead stuffing box keeps gasoline vapors out of the motor room.

7-61. Which of the following may cause the pump to malfunction?
1. Overgreased bearings
2. Bent pump shaft
3. Excessive pump stuffing box leakage
4. Any of the above

In items 7-62 through 7-65, select from column B the pump component that is associated with each statement in column A.

	A. Statements		B. Components
7-62.	Each joint is staggered approximately 90 degrees during its installation	1.	Wearing ring
		2.	Stuffing box packing
7-63.	Air pressure may be used to remove this component		
7-64.	Oil may be applied during the installation of this component	3.	Seal water ring
7-65.	This component is removed and replaced in a lathe		

Items 7-66 and 7-67 refer to the Blackmer rotary pump.

7-66. How are the cylinder heads attached to the pump?
1. They are bolted together
2. They are bolted to the pump casing
3. They are cast with the cylinder assembly
4. They are held in place by the bearing housings

7-67. What provisions are made on the sliding vanes to allow for the escape of liquid from between the vanes and slots of the rotor?
1. The vanes have relief grooves on their forward faces
2. The vanes have relief grooves on their back faces
3. The vanes have relief holes at their tip ends
4. The vanes have relief holes at their base ends

7-68. What should you do, if anything, when grease escapes from around the pump shaft?
1. Check the bearing cover for damage
2. Check the grease relief fitting for damage
3. Check the lip of the shaft seal for nicks, cracks, or distortions
4. Do nothing, as small amounts of grease may work past the bearings after lubrication

7-69. Which of the following statements describes the operation of the Viking transfer pump?
1. The liquid is drawn in one side and forced out the other by the action of the rotor driving three spiral-type idlers
2. The pump inlet has access to the impeller, drawing the liquid in and forcing it against the volute and out the discharge
3. The liquid is drawn in when the rotation of the rotor and idler opens the space between the gear teeth and is forced out when the rotor and idler teeth mesh
4. The liquid is picked up by the teeth on the rotor and idler at the pump intake and swept around the inside of the pump case by the teeth on the revolving gears to the discharge port

7-70. When you disassemble or assemble the Viking transfer pump, caution should be exercised in fitting the rotor and head for proper clearance.

7-71. At what point will the liquid be completely bypassed through the relief valve?
1. At approximately 75 psi
2. When the spring-loaded ball check is unseated
3. At approximately 100 psi
4. When the pump overspeeds

7-72. What is the maximum tolerance allowed when the Falk flexible coupling is aligned?
1. Axially 1/8 in., radially 0.003 in.
2. Axially 0.003 in., radially 1/8 in.
3. Axially 1/8 in., radially 1/8 in.
4. Axially 0.003 in., radially 0.003 in.

7-73. How are the coupling halves of the Lovejoy pump and motor cushioned?
1. By phenolic spacer
2. By formed rubber spider
3. By air baffle
4. By insarok disc

7-74. Which type of aircraft fueling station is the most widely used?
1. Wayne
2. Cla-Val
3. Wheeler
4. Blackmer

Assignment 8

Maintenance and Repair; Administration

Text: Pages 242 - 269

Learning Objective: Identify capabilities and characteristics of the Blackmer service station.

8-1. Refer to figure 9-23 in your textbook. Which statement concerning the two valves contained in the Blackmer fueling pump control valve is correct?
1. They are spring-opened, pressure-closed, and diaphragm-operated
2. They are spring-opened, spring-closed, and pressure-operated
3. They are pressure-opened, pressure-closed, and diaphragm-operated
4. They are pressure-opened, spring-closed, and pressure-operated

8-2. Which one of the Blackmer four-way valves operates independently from the others?
1. Single-port suction return valve
2. Double-port valve
3. Single-port suction valve
4. The poppet restriction valve

Learning Objective: Identify operating characteristics of the Cla-Val fueling station.

8-3. Which statement relative to the functions of the fuel-defuel valve is INCORRECT?
1. It acts as an emergency shut[illegible]ve
2. It evacuates the entire piping system
3. It maintains constant discharge pressure
4. It relieves discharge pressure rising above a predetermined level

8-4. The two globe valves of the station have reinforced and supported diaphragms. These diaphragms serve to
1. overcome spring pressure to close both valves
2. overcome spring pressure to open both valves
3. open the fueling valve and close the defueling valve against spring pressure
4. open the defueling valve and close the fueling valve against spring pressure

8-5. The diaphragm operation is pressure-protected due to the function of the
1. pilot valve
2. valve cover chamber
3. pilot valve system
4. pressure relief control valve

8-6. Spring action holds which of the following valves closed?
1. Pressure-reducing valve
2. Pressure relief control valve
3. Hytrol valve
4. Both 1 and 2 above

8-7. How is constant fuel delivery pressure maintained in the station?
1. The constant adjustments of the globe valve adjusting screw by the operator balance spring force against the fuel pressure
2. The force of the compressed valve spring overcomes the delivery pressure of the fuel
3. The pressure of the flowing fuel overcomes the force of the valve spring
4. The pressure under which the fuel is delivered is balanced against the pressure exerted by the valve spring

8-8. Which valve prevents the fuel valve from slamming and the fuel hose from becoming charged too quickly by controlling the operation of the fuel valve?
1. Pressure relief valve
2. Pressure-reducing valve
3. Flow control valve
4. Hytrol valve

8-9. The solenoid valve performs which of the following functions during defueling?
1. It closes the hytrol valve by venting its cover
2. It directs high pressure to hold the hytrol valve and fueling valve closed
3. It vents the defueling valve allowing it to open
4. It performs both 2 and 3 above

8-10. Which valves will open if there is an increase in the downstream pressure that is high enough to overcome the force of the spring?
1. Both relief valves and the defueling valve
2. The defueling valve and its associated relief valve
3. The pressure-reducing valve and both relief valves
4. The solenoid valve, both relief valves, and the defueling valve

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Learning Objective: Recognize the principle of operation of the automatic pressure regulator.

8-11. A pressure gage must be installed in the line between the fuel/defuel valve and hose when setting the Cla-Val for final delivery pressure.

8-12. Unlike the Cla-Val system of maintaining constant fuel flow, this system balances venturi throat pressure against the force exerted by the pilot valve spring to maintain pressure at a constant level.

● Items 8-13 through 8-15 refer to the automatic pressure regulating system.

In items 8-13 through 8-15, select from column B the function that is performed by each component listed in column A.

A. Components	B. Functions
8-13. Ejector strainer assembly	1. Prevents chatter in the main valve
8-14. Control valve	2. Controls the operation of the pilot valve
8-15. Venturi tube	3. Closes the main valve quickly when downstream pressure builds up
	4. Restricts the flow through the ejector strainer assembly

8-16. Which of the following represents the correct sequence of fuel flow during normal operation of the system?
1. Main valve body → pilot valve → venturi tube throat → ejector strainer assembly
2. Main valve body → ejector strainer assembly → pilot valve → venturi tube throat
3. Main valve body → pilot valve → ejector strainer assembly → venturi tube throat
4. Main valve body → venturi tube throat → pilot valve → ejector strainer assembly

8-17. A decrease in riser pressure will allow the pilot valve and the main valve to open wider.

8-18. What are the correct positions of the pilot, main, and control valves when there is a sudden demand decrease in the flow rate?
1. Pilot - open; main - open; control - closed
2. Pilot - open; main - closed; control - closed
3. Pilot - closed; main - open; control - open
4. Pilot - closed; main - closed; control - open

Learning Objective: Recognize your responsibilities relative to pertinent technical publications issued by the Naval Sea Systems Command, types and contents of these publications, and the policy for their security.

8-19. Senior petty officers' responsibilities relative to publications dealing with the operation and maintenance of pertinent equipment include knowing how to do which of the following?
1. Procure needed publications
2. Keep the publications up to date
3. Interpret the publications and supervise their use
4. All of the above

8-20. Publications issued by the Naval Sea Systems Command cover which of the following?
1. Shipboard fueling equipment
2. Aircraft handling equipment
3. Mobile refuelers
4. All of the above

8-21. The allowance list of spare parts needed for a ship's aviation fuels system is known as the
1. AVCAL
2. COSAL
3. FOCSL
4. RIAL

8-22. If all of the publications of the commissioning allowance have NOT been received by a ship 30 days prior to the commissioning date, a request for these publications should be sent to the appropriate issuing activity.

8-23. Which statement relative to the difference between Parts D and E of the NAVSUP publication 2002 is correct?
1. D is an alphabetical listing of damage control texts, and E is a numerical listing of NAVSEA manufacturers' technical manuals
2. D is a numerical listing of ship electronic equipment, and E is an alphabetical listing of NAVSEA manufacturers' technical manuals
3. D is an alphabetical listing of damage control texts, and E is a numerical listing of ship electronic equipment
4. D is a numerical listing of NAVSEA manufacturers' technical manuals, and E is an alphabetical listing of the same manuals

8-24. A request for NAVSEA publications over and above the commissioning allowance can be made for which of these reasons?
1. Replacement of copies destroyed
2. An increase of allowance
3. The addition of publications to the allowance
4. Any of the above

8-25. Whenever looseleaf changes are made to a publication, the obsolete pages that are removed should be destroyed immediately.

8-26. Which of the following makes the security policy for classified material in the Navy?
1. Secretary of the Navy
2. Chief of Naval Operations
3. Director of Naval Intelligence
4. Secretary of Defense

8-27. The Navy Directives Issuance System is concerned with which of the following functions?
1. To aid in controlling all directives on naval air stations
2. To provide a directive for control of all technical manuals
3. To provide a uniform method of issuing and maintaining notices
4. All of the above functions

Learning Objective: Recognize where and how blueprints and drawings of a CVA fuels system are filed.

8-28. A set of blueprints of the fuel systems of a CVA should be kept on file in damage control central or the engineering log room.

8-29. Which part of the blueprint number CVA 34-504-1567, Alt. 4 determines the numerical order in which the print is filed?
1. Alt. 4
2. CVA 34
3. 504
4. 1567

Learning Objective: Recognize types and uses of publications which identify spare parts and equipage.

8-30. Which of the following information is required by supply to procure needed spare parts or equipment?
1. Part number
2. National stock number
3. Complete nomenclature
4. All of the above

8-31. The Coordinated Shipboard Allowance List (COSAL) provides the supply officer with the needed information to stock parts and equipage for an indefinite period.

8-32. The ABF is primarily concerned with which of the following types of COSALs?
1. ASO
2. ESO
3. SPCC
4. NAVELEX

8-33. The introduction section of the COSAL contains which of the following details?
1. Duties and responsibilities of the supply department
2. Codes and abbreviations
3. Procedures for making corrections
4. Both 2 and 3 above

In items 8-34 through 8-38 select from column B the component of the SPCC COSAL described in column A.

	A. Description	B. Component
8-34.	Contains a numerical list of all APLs and AELs	1. APL 2. AEL
8-35.	Contains the same information of APLs and AELs in two different formats	3. Index 4. Summary
8-36.	Designed to provide maintenance and repair support for ship's equipment	
8-37.	APL/AEL numbers may be found by looking for the name or use of the equipment	
8-38.	Provides management personnel with listings of equipage and supplies required to operate the ship effectively	

8-39. Equipage is a term used to designate items of a durable nature that are NOT consumable.

8-40. In order for the COSAL to be an effective management tool, it must be kept current. Which of the following conditions require(s) a report to ensure completeness of the COSAL?
1. When equipment is received or removed
2. To correct an error
3. Change of service application
4. All of the above

8-41. If the National stock number of a part is known, which one of the following sources should be used to find an equivalent part?
1. Cataloging Handbook, H4-1
2. Cataloging Handbook, H4-2
3. Navy Stock List of ASO
4. NAVAIR Allowance List, Section K

8-42. Bimonthly Change Bulletins are distributed to update the Master Cross-Reference List and sections of the
1. ASO Cross-Reference
2. NAVSUP 2002
3. SPCC
4. FOCSL

8-43. If the only information available about a part is the manufacturer's part number, to which section of the Navy Stock List of ASO should you refer to determine the part's NSN?
1. Parts List section
2. Descriptive section
3. Cross-Reference section
4. Price and Management Data section

8-44. An Initial Outfitting List establishes an allowance of specific support material which is expected to be adequate for a period of
1. 1 month
2. 3 months
3. 6 months
4. 9 months

8-45. What publications are used to determine the nomenclature, identification numbers, and suppliers of equipment for which the Navy does NOT provide a catalog?
1. Allowance lists
2. Maintenance Instructions Manuals
3. Illustrated Parts Breakdown Lists
4. Manufacturer's parts lists and catalogs

Learning Objective: Identify the contents, routing, and uses of the DD Form 1348 when requesting material.

8-46. To expedite identification and issue of requisitioned material, it is important that the DD Form 1348 include a correct identification of which of the following?
1. The stock number
2. The nomenclature
3. The manufacturer's part number
4. All of the above

8-47. The DD Form 1348 requesting the issuance of technical aeronautical material to the V-4 division is first submitted to the
1. supply office
2. operations department
3. aviation stores division
4. storeroom in which the material is stowed

8-48. If you submit a request for in-excess material, you must justify in writing why the item is needed and why the authorized material wil NOT suffice.

8-49. The single line item requisition, DD Form 1348, is the request document for nonstandard material.

Learning Objective: Determine who initiates and conducts surveys and the steps in completing them.

8-50. A request for informal survey will be initiated by the person responsible by completing a NAVSUP Form 154. Which officer will sign the request for survey action?
1. The commanding officer of the surveying activity
2. The supply officer of the surveying activity
3. The head of the department having custody of the material to be surveyed
4. Either 1 or 2 above

8-51. Formal surveys are conducted by personnel appointed by the
1. cognizant office or bureau
2. commanding officer of the surveying activity
3. supply officer of the surveying activity
4. head of the department having custody of the material to be surveyed

8-52. In which order do the following steps occur in completing a formal survey?

A. The cognizant department submits a rough NAVSUP Form 154 requesting survey of material

B. The NAVSUP Form 154 is forwarded to the designated survey officer(s)

C. Smooth copies of the survey form are prepared in accordance with local instructions and are forwarded to the commanding officer

D. The commanding officer reviews the survey recommendations and, if he approves, forwards a copy to the fleet command

E. The designated survey officer(s) attach(es) a statement of originator to the smooth NAVSUP Form 154.

F The item is expended in accordance with the survey recommendations after the commanding officer approves

G. The commanding officer designates the survey officer(s)

H. Disciplinary action is taken if culpability is established

1. A, B, C, D, E, F, G, H
2. A, B, C, D, H, F, E, G
3. A, C, G, B, E, D, F, H
4. A, C, H, G, D, F, E, B

Learning Objective: Recognize the accountability codes for various types of items.

In items 8-53 through 8-55, select from column B the accountability code to which each type of item described in column A applies.

A. Items

8-53. Items which may be exchanged when replacement is required but which are usually repaired locally

8-54. Items which may be repaired by a major rework activity economically, and are maintained on a custodial basis

8-55. Items, except support equipment, which may be repaired economically on a programmed basis by a major rework activity

B. Codes

1. R
2. L
3. D
4. B

Learning Objective: Recognize purposes of maintenance logbooks and inventory cards.

8-56. Each department having custody of equipage must conduct an inventory at least
1. monthly
2. quarterly
3. semiannually
4. annually

8-57. Relative to the maintenance logbook, which of the following statements is correct?
1. All logbooks maintained by repair crews should be made in duplicate and both copies filed in the V-4 division office
2. The maintenance logs for oil pumps, tanks, gages, and valves should contain information regarding operating time and an inspection record
3. Entries regarding all work performed by the repair crews should be made in the logbook on a day-to-day basis
4. The maintenance logbooks must be inspected by the ship's supply officer and the air officer at frequent, regularly scheduled intervals

8-58. Which phrase is most indicative of the primary purpose of inventory cards?
1. Save time
2. Teach economy
3. Control inventory
4. Predict resupply

Learning Objective: Define the functions of fuel checkers, and indicate the uses made of checker cards or sheets and of the daily fuel reports.

8-59. Inasmuch as the measuring instruments are NOT accurate enough to use in computing fuel expenditures for a particular squadron, fuel checkers are assigned the duty of keeping accurate records of all fuel issued to or removed from a squadron's aircraft.

8-60. The checker cards or sheets are used for which of the following purposes?
1. To fill out squadron requisitions
2. To show the time of fueling and the load in the aircraft
3. To account for the amount of fuel aboard the ship
4. All of the above

8-61. The total amounts of each type of aviation fuel on board can be determined from the daily fuel report.

8-62. Because there is a possibility of tank gaging equipment inaccuracies, it is mandatory that each tank be sounded at least once each
1. hour
2. day
3. week
4. month

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